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AND

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ENGINEERING NEWS.

THE READING TERMINAL enterprise is still being fought over in the Philadelphia councils. Public interest in the matter is aroused, and at the city election on Feb. 18 a strong effort is to be made to defeat the councilmen who have opposed the Reading company from the beginning.

An ordinance which has attracted much attention has been introduced in the councils providing for the appointment of a rapid transit commission, to consist of representatives of the various street railway and steam railway companies now operating in the city, and the chief city officials, with five representative citizens. This body would canvass the whole question of rapid transit for Philadelphia, and make such a report as it saw fit.

Another scheme, which has been broached, is that Broad St. station be enlarged and made a union station, into which trains of the Pennsylvania, Reading, Baltimore & Ohio, Belt Line, and any other railway company entering the city, should run upon equal terms. It is probable, however, that no such radical moves will be made, but that the Reading company will eventually be permitted to go ahead and construct its terminal at Market St.

A DEPRESSED FOUR-TRACK railway is projected for Atlantic Ave., Brooklyn. The Long Island R. R. has offered to build a 4-track elevated road down the avenue, which is strongly opposed by the residents along the route. A plan has been outlined under which the city would build the road, raising the money for the purpose by an issue of 2½ per cent. 50 year bonds and lease it to the Long Island R. R. at a rental of 4½ to 5 per cent. on the cost. Long before the bonds were due the rent would have extinguished both principal and interest. The plan seems to be an excellent one for both the city and the railway company. Two of the tracks would be used for through and two for local traffic, and extensive terminals would be erected at South Ferry.

THE NEW MT. AUBURN INCLINED PLANE, at Cincinnati, O., was opened to travel on Feb. 9, as reconstructed on the plans of Mr. GEORGE HORNUNG, Consulting Engineer. Every precaution has been taken to make the entire structure and its machinery absolutely safe against any reoccurrence of the accident of several months ago. We hope to be able to illustrate it in detail shortly.

VIADUCTS OVER WEST ST., NEW YORK, are being planned by the Pennsylvania and the New Jersey Central railway companies, both of which have now received permission for erection from the city authorities. The Jersey Central viaduct will span West St. from Rector to Pier 8. It will be a light steel span of 81 ft. long and 8 ft. wide, having 16 ft. headway beneath. The viaduct of the Pennsylvania road would cross diagonally to Cortlandt St. with a clear span of 100 ft., 8 ft. wide and 16 ft. above the street. Both roadways will be proportioned to stand 100 lbs. to the sq. ft.

THE LONDON AND SOUTHWARK SUBWAY is very nearly completed, says the London *Morning Post*. But between Kennington and Stockwell there is some considerable trouble, and a section of 30 ft. in one tunnel and about 100 ft. in the other still remain to be excavated. About this place the tunnel passes through a bed of sand and gravel under a 35 ft. head of water, caused by a dip in the London clay formation in which the tunnel generally is excavated.

Mr. GREATHEAD, the engineer, adopted compressed air as a means of holding back this water, under a pressure of about 15 lbs. per sq. in. Strong brick bulkheads were built in the rear of the diaphragm, placed back of the cutting shield, and provided with tight fitting doors; both of the chambers thus formed are filled with compressed air, and serve the purpose of an air lock. One of the tunnels has been driven through this gravel pocket a distance of about 200 yards at the rate of 4 ft. 6 ins. per day. When working through the clay with the Greathead shield, a progress of 13 ft. in 24 hours was made.

STREET RAILWAYS IN THE UNITED KINGDOM are dealt with in a recent Parliamentary paper. The authorized capital of street and road tramway companies in the United Kingdom for the year ending June 30, 1888, was $91,919,270, and for the period ending June, 1889, $90,639,400. The capital paid in, in 1888, was $68,453,320, and, in 1889, $67,784,815. Other figures for 1888 show that 904 miles of line were opened for public traffic, and that the companies had 25,832 horses, 514 locomotive engines and 3,501 cars. The number of passengers carried was 428,906,045, the gross receipts being $13,931,495, the working expenses $10,872,170, and the net receipts $3,109,325. For 1889, the figures were: Length of lines, 949; horses, 27,000; locomotive engines, 539; cars, 3,645; passengers, 477,596,268; gross receipts $14,901,120; working expenses, $11,333,405; net receipts, $3,567,715.

THE WEST END STREET RY. CO., of Boston, Mass., operates 253.20 miles of line. During the year ending Sept. 30, 1889, 525,366 miles were run by electric cars, and 16,048,465 miles with horse cars. The electric system is to be introduced on all the company's lines. It is to be regretted that the conduit system tried on one line proved unsatisfactory, and has been abandoned. The overhead wire system is not suitable for city streets. The number of passengers carried during the year was 104,243,150, an average of 6.29 passengers per mile. The equipment consists of 1,794 horse cars and 47 electric cars. The number of horses is 7,728. The gross earnings amounted to $5,249,902.62; operating expenses, $4,099,037; net earnings, $1,150,865.62.

BOSTON, MASS., now has 404 miles of streets, and the Superintendent of Streets, Mr. J. E. JONES, says that it will cost $1,500,000 annually for a series of years to put them in perfect order. In addition to these there are 135 miles of "private ways." During the last 19 years 105.6 miles of new streets have been laid out.

THE WESTINGHOUSE ELECTRIC LIGHT CO. now virtually controls the Subway Co., of New York, by a consolidation of the interests of the Brush, Thomson-Houston and Westinghouse interests in this city.

AN ELECTRIC RAILWAY is to be established at the exhibition to be held at Edinburgh, Scotland, this year. The secretary of the Electrical and Lighting Committee is receiving proposals for working the line. The executive proposes to lay and fence a standard gauge track, about 1,000 yds. in length, serving at least two intermediate stations, in addition to the termini. The railway will not be a mere experimental length, but will be laid out so as to be of real utility to visitors in getting from point to point in the extensive grounds, and to and from the railway stations, etc., so that a considerable traffic is expected. The executive will supply power, if required, on certain conditions; but contractors must equip the track with motors, cars, conductors, turnstiles, and other appliances, and pay the executive a proportion of the receipts.

"DROP A PENNY IN THE SLOT AND GET A LIGHT" is a late device on the gloomy District Underground Ry. of London to aid the traveler in killing time by reading. As described, the light is electric, in a box attached to the side of the car. In this box is a slot, and by dropping in a penny the light is switched on for 15 minutes; but another penny can bring it back for another quarter of an hour. Our account does not state how many such boxes are placed in an English compartment car.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of a passenger train, Feb. 8, on the Norfolk & Western Railroad near Glade Springs, Va. The accident is said to have been caused by a train running at a high speed round a sharp curve, the track on which was in bad condition. One account states that the ties were old and worn out. The whole train, except the engine, went down the bank. One man was killed and six were injured, two of them fatally. One car caught fire, but the flames were quickly extinguished. ——A misplaced switch caused a serious collision on the Northern Central Railway, near Harrisburg, Pa., Feb. 9. A passenger train was turned onto a side-track on which a freight train was standing. One man was killed and four were injured.——One of the side rods of an engine on the Evansville & Terre Haute R. R. broke Feb. 5, while the engine was hauling a passenger train near Evansville, Ind. The engine driver was badly scalded.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: On Feb. 5 about 100 ft. of the woodwork of the iron bridge of the New York, Chicago & St. Louis Ry. over the Chautauqua Creek, at Westfield, N. Y., was destroyed by fire. On Feb. 2 a construction train on the Union Pacific Ry. went through a trestle near Cascade locks, on the Columbia River. The supports had been undermined by the floods. Eight men were killed. Several bridges in California and Oregon have been washed away.

WASHOUTS AND SNOW SLIDES continue to be reported from the Pacific slope. In Oregon serious floods have caused much damage, and several landslides have occurred. A section of the bank of the Schuylkill River at Philadelphia, Pa., caved in Feb. 4, carrying away about 200 ft. of the Baltimore & Ohio R.R. track.

AN UNUSUAL ACCIDENT happened last August on the Rshew-Wjasma R. R., in Russia, near the Rshew station on this line. The trusses of the bridge over the Volga River were shoved some distance by the force of the wind. The movement took place at the free end, in the direction of the rollers. The length of the space moved was about 5.12 ins., so that the girders still remained on the abutments. The cause of the accident was the lack of guides on the bed-plate, thus allowing a transverse motion of the end of the trusses. The span of the bridge is 350 ft.; the total weight, 734 tons.

A DERAILING SWITCH ACCIDENT occurred Feb. 11 at South Norwalk, Conn., on the New York, New Haven & Hartford R. R. A freight train going east was switched at the station to allow an eastbound passenger train to pass. The passenger train then passed the station and crossed the drawbridge, just east of the station. When the freight train arrived at the bridge a few moments later the draw was open, but the signal, it is claimed, was not set for danger until too late to stop the heavy freight. The safety switch was open and prevented the train from going into the river. The train, however, was thrown from the track and the engine and several cars were overturned. The local press reasons from this accident, that it was not wise to abolish the old rule requiring all trains to stop at drawbridges. A correspondent writes as follows: "Had an old law, which said all trains should stop at drawbridges, been enforced, this accident, like several others, could not have happened; to say nothing of the damage done and lives imperiled." The accident appears from the press accounts to have been due to a combination of circum-

stances. There is a bell at the bridge which is rung when a train passes over a track lever some distance back, and warns the bridge-tender not to open the bridge. He claims that the bell did not ring, and he had just unlocked the draw and set the danger signal when the train came along. With proper interlocking, the unlocking of the draw would set the danger signal, and after a train had passed the signal the draw could not be unlocked. To get the full benefit of these safety devices they must be completely equipped, and we do not consider that the accident shows any objection to the derailing switch system.

FENCE SIGNS ALONG RAILWAYS are prohibited by a late order of the General Manager of the Boston & Maine R. R. He has counted up 3,500 of these signs along his road, and estimates that they cost $10,000 to the advertisers. His men are obliterating the signs with whitewash brushes.

THE RAPID GROWTH IN FAVOR OF M.C.B. COUPLERS is well illustrated by the action of the Philadelphia & Reading Co. Eight months ago, Master Car Builder JOHN H. RANKIN reported to us that no automatic couplers were in use on cars belonging to that road. Since that time, however, experiments have been in progress on the road, and as a result it is now announced that 4,000 new freight cars, now under construction at Pullman, Ill., are to be equipped with M. C. B. automatic couplers of the Van Dorston cushioned type. This is the first order of considerable size received by the Van Dorston Company, which is a comparatively new candidate for favor in the automatic coupler field, and its managers may well feel proud over their success.

LOCOMOTIVE WORKS IN NEW SOUTH WALES is wanted by that government, and Sir SAUL SAMUEL, the Agent-General for the colony, advertised recently for the establishment of such works. The bids were to be opened Feb. 14. They want a firm to build engines equal to those made by "English makers," and promise an order for 100 locomotives, to be supplied in three years, provided the price does not materially exceed that of engines delivered "in steam" at Sydney by first-class English firms. Sir SAUL SAMUEL'S address is 9 Victoria St., London, England.

THE ASSIMILATION OF RAILWAY GAUGES is being made an issue in connection with the proposed union of the Australian colonies. A correspondent, Mr. C. O. BURGE, M. Inst. C. E. writes, that in New South Wales the gauge is 4 ft. 8½ ins., 5 ft. 3 in. in Victoria and 3 ft. 6 in. ins Queensland; South Australia has several gauges. Mr. BURGE is now sent by the Government on a mission to Queensland to arrange for a connection of railway systems, by a coast line, between that colony and New South Wales.

THE RAILWAY IN SOUTH AFRICA, from Delagoa Bay to Pretoria, in the Transvaal, is to run for 346 miles along a route sketched out by Sir Thomas Tancred, if the Boers will permit it. The line would run past the gold fields of Barberton, and 35 miles from the newly developed ones at Johannesburg. The company starts with a capital of $2,500,000, raised in London, and liberal concessions from the Portuguese Government, one of which is a grant of 250,000 acres of land. Meanwhile, the Natal Government, whose line runs already between Durban and Ladysmith—189 miles of mountainous country—is rapidly pushing on its railway system to Newcastle 70 miles, whence it is proposed to reach the Transvaal boundary, 40 miles further north.

THE SIAMESE GOVERNMENT RAILWAYS are to be of standard gauge—namely, 4 ft. 8½ ins. The projected railway east from Bangkok to the Mekong River, about 440 miles long, has been favorably launched. Sir ANDREW CLARKE'S syndicate offered to find half the capital and construct the line, charging 10 per cent. commission on the cost price. The first section of 55 miles to Patrew will be begun immediately, says an English exchange. Half the capital will be found by Siam, and the company will be formed under Siamese laws. The Government Engineer of Siam, under whom these roads are to be built, is Mr. ROBERT GORDON, M. Inst. C. E., well known to American engineers as a strong advocate of American railway practice.

The Service Record of M. C. B. Standard Janney Freight Couplers.

By the kindness of the manufacturers, The McConway & Torley Co., of Pittsburg, Pa., we are enabled to present in this issue, in response to a request for data as to the actual facts of experience in regard to the cost of maintenance of the M. C. B. standard type of automatic coupler, the following unique record covering the details of all breakages of all the Janney freight couplers which have so far been put into service since the adoption of the M. C. B. type, in so far as reports of breakages have been made to the manufacturers, or were obtainable from the companies. The record is believed to be complete for 45,617 couplers on 11 leading lines, their average term of service, as shown in detail below, having been about 10 months. It also includes partial reports from 25,814 couplers more, most of them of more recent service, from which but very small lists of breakages are as yet obtainable, and which, as presumably imperfect, are neglected in the abstracts and deductions below, only those being included which were known to be complete, both in number of breakages and in exact reports as to the nature and location of each breakage.

We need not say that such a record is one of quite unparalleled magnitude, as well as of quite unique interest and value at the present time, when the officers of the whole railway system of the country are hesitating only for definite light as to what the service value of the new type of coupler is before pushing rapidly its introduction; and in the meantime they are proceeding somewhat cautiously, although even now the introduction is going on at a rapid rate, as the map of automatic brake and coupler introduction published in our issue of Dec. 21, 1889, showed graphically in every sense. This anxiety on the part of railway officials to ascertain the exact facts, coupled with an equally natural desire on the part of the manufacturers to ascertain and collate them, has led to the collection of a mass of definite records such as, we risk nothing in saying, has never been approached before in regard to any one mechanical device, the whole of which records we are now able to lay before our readers.

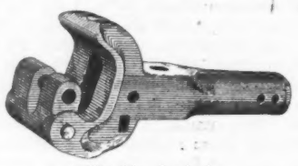


Fig. 34.—Locked.

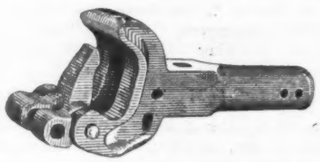


Fig. 35.—Open.

The Janney Car Coupler.

[Reduced from photographs of the actual coupler laid on its side to obtain a better view.]

We may add further that the records, as laid before us, consisted merely of the original reports of the individual fractures, which we have classified for ourselves in the case of two of the twelve companies given in detail (viz., the New York Central and the Chicago, Burlington & Quincy), and in the case of the remaining nine companies merely of the original classified abstracts from these lists as given in Tables 1 and 2. We are promised shortly similar records for 4,648 couplers on the Richmond & Danville.

We premise further, as a fact which we wish to be borne in mind throughout, that ALL THE INFERENCES, DEDUCTIONS, PERCENTAGES, ETC., GIVEN HEREAFTER ARE OUR OWN SOLELY, prepared without consultation with, or even the knowledge of, the manufacturers, who see them for the first time here in print. The original records were simply turned over to us with *carte blanche* as to the method of treating them. If, therefore, we err in any respect by unduly favorable or unfavorable deductions, or by imperfect record of governing conditions, the fault is wholly our own. On the other hand, we need hardly say to our readers that we have analyzed the records without color of interest, otherwise than to present the plain, unvarnished truth.

We may also premise at once, what the reader will not have to read far to find out for himself, that the record constitutes proof of a high character—vastly stronger than we could have imagined to be yet possible, or than would have been possible except for the causes leading to special care which we have noted—that this particular make at least, of M. C. B. couplers, is as nearly perfect mechanically as respects liability to fractures as it is ever likely to become; that its maintenance cost is already much below that of the common drawbar, link and pin, and yet that at least two-thirds of the present fractures in service are plainly due to the exceptional conditions of the transition period, during which the M. C. B. type is necessarily run largely in connection with old-style drawbars. It seems possible from these records that much more than two-thirds of the fractures may disappear with the transition period; yet it is not necessary to assume any future decrease to have an ample case for doing away with the old style of drawgear on maintenance grounds alone. We are surprised and gratified to find that so entirely conclusive proof to this effect as that which follows can be advanced at this early day, and cannot but believe that it will have a

TABLE 1.

SUMMARY BY CAUSES OF ALL COUPLER BREAKAGES.

(Abstracted from detail sheets like Table III.)

Memo. Nos.	Nature of fracture.	Number broken.	Total No. in service.	Per ct. broken.
1	Arm off	280	67,643	.0041
2	Arm chipped	22	67,643	.0003
3	Arm cracked	2	67,643	.0003
4	Lower lug off	68	67,643	.0010
5	Upper lug off	32	67,643	.0005
6	Both lugs off	40	67,643	.0006
7	Both lugs and back off	10	67,643	.0001
8	Split Back	171	67,643	.0025
9	Back out	10	67,643	0.01
10	Split face	18	67,643	.0002
11	Head off at neck	53	67,643	.0007
12	Head off at shoulder	96	67,643	.0014
13	Head off at neck and arm off	7	67,643	.0001
14	Head off at shoulder and arm off	7	67,643	.0001
15	Head off thro' shoulder	6	67,643	.0001
16	End of barrel split off.	2	67,643	.0003
17	Bracket off	8	67,643	.0001
18	Bracket cracked	13	67,643	.0002
19	Miscellaneous	92	67,543	.0013
20	Draft bolt pulled through	16	67,643	.0002
		953	67,643	.0141

	Number.	Per ct.
Total number of broken couplers returned from July 10, 1888, to Jan. 1, 1890	953	67.2
Good metal	315	32.8
Couplers replaced through mechanical defects	640	100.0

TABLE 2.

SUMMARY BY CAUSES OF ALL KNUCKLE BREAKAGES.

(Abstracted from detail sheets like table III.)

Memo. Nos.	Nature of fracture.	Number Broken.	Total No. in Service.	Per ct. Broken.
21	Upper lug off	408	67,643	.0060
22	Upper lug chipped	274	67,643	.0041
23	Upper lug cracked	135	67,643	.0019
24	Lower lug off	107	67,643	.0016
25	Lower lug chipped	37	67,643	.0005
26	Lower lug cracked	32	67,643	.0005
27	Both lugs off	90	67,643	.0013
28	Both lugs chipped.	82	67,643	.0012
29	Both lugs cracked.	6	67,643	.0009
30	Upper lug off and lower chipped	56	67,643	.0008
31	Lower lug off and upper chipped	51	67,643	.0007
32	Tail off	44	67,643	.0006
33	Miscellaneous	10	67,643	.0001
		1,332	67,643	.0196

TABLE 3.

DETAIL SUMMARY FOR ITEM NO. 1, ARM OFF.

(A sample of those received for each one of the 33 items of breakage. Each table headed by a sketch like those reproduced in Figs. 1 to 33.)

From whom.	Number broken.	Total No. in service.	Per ct. Broken
Penn. R.R.	117	8,274	.0141
C., R. I. & P.	18	3,372	.0053
P. W. & B.	8	808	.0099
N. Y. C. & H. R.	....	2,605	....
Ensign M'f'g. Co.	....	2,099	....
N. Y. C. & St. L.	3	360	.0083
R. & D.	....	4,648	....
W. C. & A.	....	404	....
P. C. & St. L.	....	6,271	....
L. S. & M. S.	11	4,534	.0024
West Shore	6	430	.0139
Penn. Co.	12	4,996	.0024
N. Y., L.E. & W.	102	7,611	.0134
C., C., C. & St. L.	2	3,938	.0005
H. & St. J.	....	60	....
W. N. Y. & P.	1	1,665	.0006
Miscellaneous	....	15,658	....
Totals	280	67,643	.0041

ARM.

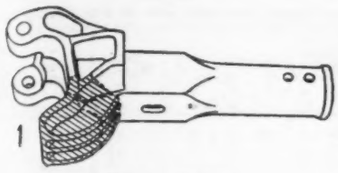


Fig. 1. Arm off.

No.	E. 240	W. 49	289
P. c. yearly.	E. 0.91	0.53	0.82

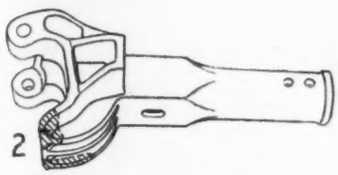


Fig. 2. Arm chipped.

No.	E. 13	W. 13	26
P. c. yearly.	0.05	0.14	0.07

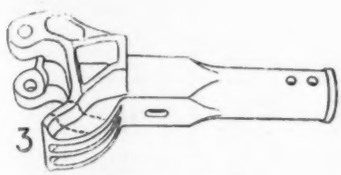


Fig. 3. Arm chipped.

No.	E. 1	W. 4	5
P. c. yearly.	E. 0.01	W. 0.04	0.02
Total arms.	**E. 254**	**W. 66**	**320**
P. c. yearly.	**0.97**	**0.90**	**0.96**

LUGS.

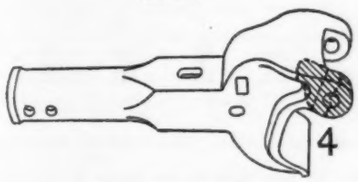


Fig. 4. Upper lug off.

No.	E. 58	W. 19	77
P. c. yearly.	0.22	0.21	0.22

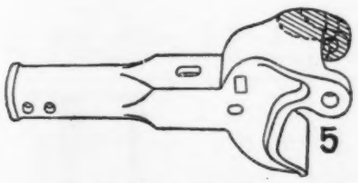


Fig. 5. Lower lug off.

No.	E. 26	W. 9	35
P. c. yearly.	0.10	0.10	0.10

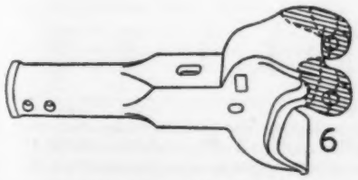


Fig. 6. Both Lugs Off.

No.	E. 28	W. 14	42
P. c. yearly.	0.11	0.15	0.12

LUGS—(Continued).

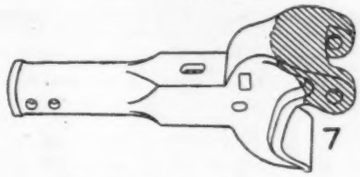


Fig. 7. Both Lugs and Back Off.

No.	E. 9	W. 5	14
P. c. yearly.	0.03	0.05	0.04
Total lugs.	E. 121	W. 47	168
P. c. yearly.	**0.46**	**0.65**	**0.57**

BACK.

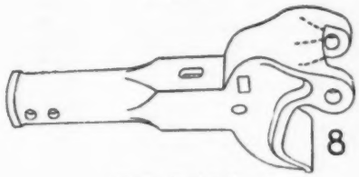


Fig. 8. Back Split.

No.	E. 144	W. 10	154
P. c. yearly.	E.	W.	

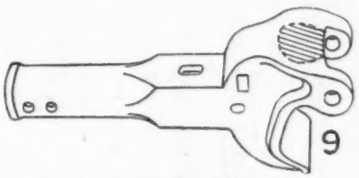


Fig. 9. Back Out.

No.	E. 8	W. 2	10
P. c. yearly.			
Total backs.	E. 152	W. 12	164
P. c. yearly.	**0.58**	**0.17**	**0.48**

FACE.

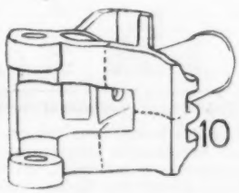


Fig. 10. Face Split.

No.	E. 13	W. 1	14
P. c. yearly.	0.05	0.01	0.04

SHANK.

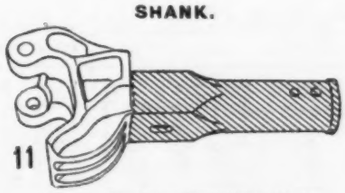


Fig. 11. Shank (or Head) Off at Neck.

No.	E. 48	W. 6	54
P. c. yearly.	0.18	0.07	0.15

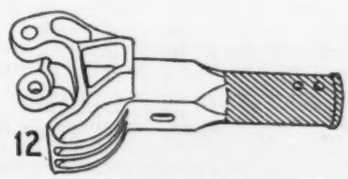


Fig. 12. Shank Off at Shoulder.

No.	E. 67	W. 34	101
P. c. yearly.	0.25	0.34	0.28

SHANK—(Continued).

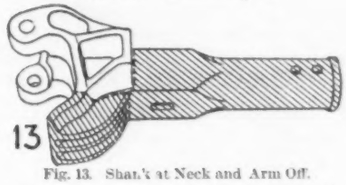


Fig. 13. Shank at Neck and Arm Off.

No.	E. 6	W. 1	7
P. c. yearly.	0.2	0.01	0.02

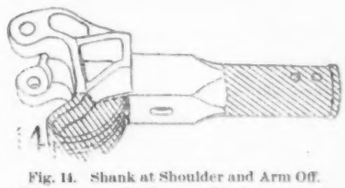


Fig. 14. Shank at Shoulder and Arm Off.

No.	E. 7	W. 0	7
P. c. yearly.	0.03	—	0.02

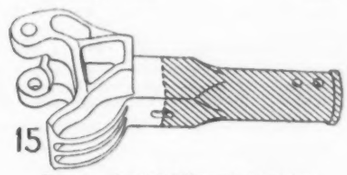


Fig. 15. Shank Off through Shoulder.

No.	E. 5	W. 3	8
P. c. yearly.	0.02	0.03	0.02

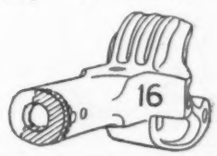


Fig. 16. Shank Off at End (or End Barrel Split Out).

No.	E. 0	W. 3	3
P. c. yearly.	—	0.03	0.01

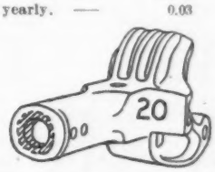


Fig. 20. Bolt Pulled Through.

No.	E. 12	W. 3	15
P. c. yearly.	0.05	0.04	0.04
Total shanks.	E. 145	W. 50	195
P. c. yearly.	**0.55**	**0.70**	**0.57**

BRACKET.

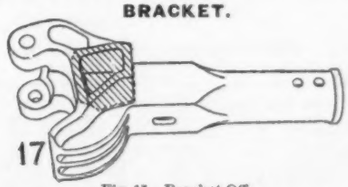


Fig. 17. Bracket Off.

No.	E. 8	W. 1	9
P. c. yearly.	0.03	0.01	0.02

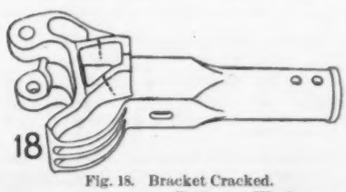


Fig. 18. Bracket Cracked.

No.	E. 11	W. 2	13
P. c. yearly.	0.04	0.02	0.04
Total brackets.	E. 19	W. 3	22
P. c. yearly.	**0.07**	**0.04**	**0.06**
Total miscellaneous.	E. 28	W. 64	92
P. c. yearly.	**0.11**	**0.69**	**0.26**

THE SERVICE RECORD OF M. C. B. STANDARD JANNEY COUPLERS.

Diagrams showing the various kinds of Breakages of Coupler proper, which are separately classified, with the Number of each which have occurred to Date, as shown in Detail in Tables 4, 5 and 6.

The Diagrams are correct reductions of actual photographs. The letters E. and W. under the cuts signify Eastern and Western aggregates or averages.

Knuckle Breakages are similarly shown on a following page.

TABLE 4.

COMPLETE LIST BY COMPANIES AND KINDS OF FRACTURE OF ALL FAILURES OF JANNEY FREIGHT COUPLERS, KNOWN TO HAVE OCCURRED AND SO FAR REPORTED

Mem. No.	Coupler Fractures.	Penna.	Erie.	Penna. Co., etc.	W. N. Y. & P.	P. W. & B.	Total Eastern Cos.	L. S. & M. S.	N. Y. C. & H. R.	C., C., St. L. & C.	C., R. I. & P.	C., B. & Q.	N. Y., C. & St. L.	Total Western Cos.	Grand Total.	Other Cos. not fully reporting.
1	*Arm* off	117	102	12	1	8	240	11	9	2	18	6	3	49	289	6
2	" chipped	5	6	..	1	1	13	4	5	..	3	..	1	13	26	1
3	" cracked	1	..	..	..	..	1	..	2	..	1	1	..	4	5	..
4	*Lugs*, upper off	14	40	3	..	1	58	1	11	..	5	1	1	19	77	3
5	" lower off	16	6	2	..	2	26	3	1	1	2	2	..	9	35	..
6	" both off	6	20	2	..	..	28	2	1	2	8	1	..	14	42	..
7	" and back off	3	5	1	..	..	9	..	4	..	1	..	..	5	14	..
8	*Back* split	45	94	1	1	..	144	1	5	..	2	2	..	10	154	24
9	" out	4	1	2	..	1	8	..	..	..	2	..	..	2	10	..
10	*Face* split	7	5	1	..	..	13	..	..	..	1	..	..	1	14	4
11	*Shank* off at neck	31	10	4	2	1	48	1	1	3	1	..	..	6	54	..
12	" " " shoulder	47	10	4	5	1	67	5	8	1	17	3	..	34	101	6
13	" " " neck & shoulder	5	..	1	..	..	6	..	..	..	1	..	..	1	7	..
14	" " " arm " "	4	3	..	..	..	7	..	..	..	..	..	..	....	7	..
15	" " thro' shoulder	1	3	..	1	..	5	..	2	..	1	..	..	3	8	..
16	" " at end	..	..	..	..	..	..	..	..	..	2	1	..	3	3	..
20	" bolt pulled through	9	..	3	..	..	12	..	..	..	3	..	..	3	15	..
17	*Bracket* off	8	..	..	..	..	8	..	..	..	..	1	..	1	9	..
18	" cracked	11	..	..	..	..	11	1	..	..	1	..	..	2	13	..
19	Miscellaneous	21	5	1	1	..	28	..	..	..	63	1	..	64	92	1
	Total coupler breaks	355	310	40	12	15	732	29	49	9	132	19	5	243	975	45

Total number of the above couplers returned to the manufacturers 953
Of these there were replaced by the manufacturers because of mechanical defects 640

Leaving as the total number of fractures where no defect existed 313

KNUCKLE FRACTURES:

21	*Upper Lug* off	68	64	81	32	17	262	39	33	23	84	13	..	192	454	..
22	" " chipped	55	15	41	35	5	151	47	11	5	66	1	5	135	286	..
23	" " cracked	37	16	22	16	2	93	11	1	2	22	2	7	45	138	..
24	*Lower Lug* off	31	16	14	12	2	75	16	22	3	11	..	1	53	128	1
25	" " chipped	9	2	4	4	1	20	7	9	3	7	1	..	27	47	..
26	" " cracked	6	2	6	4	..	18	3	1	3	7	..	1	15	33	..
27	*Both Lugs* off	21	5	20	9	3	58	12	4	10	10	9	..	45	103	..
28	" " chipped	13	8	10	10	..	41	3	9	7	26	1	3	49	90	..
29	" " cracked	1	..	..	..	..	1	2	..	..	3	..	..	5	6	..
30	" broken upper most	5	5	9	5	1	25	11	15	4	16	1	..	47	72	..
31	" " lower most	1	2	5	7	1	16	12	2	4	18	1	1	38	54	..
32	*Tail* off	4	4	1	..	..	9	21	3	4	10	1	..	39	48	..
33	Miscellaneous	3	..	5	1	..	9	1	..	..	..	..	..	1	10	..
	Total broken knuckles	254	139	218	135	32	778	185	110	68	280	30	18	691	1,469	1
Total couplers in service		8,274	7,611	11,267	1,665	808	29,625	4,534	2,605	3,938	3,372	1,183	360	15,992	45,617	25,814
Av. months of service*		12	13	7	15	16	10.63	4	9	7	9	6	12	6.94	9.34	.....
Equiv't No. in service 1 year		8,274	8,245	6,572	2,081	1,077	26,249	1,511	1,954	2,297	2,529	592	360	9,243	35,492	.....

*Number of months' service which all couplers have performed, divided by total number of couplers now in service.

The New York Central and C., B. & Q. records above, were tabulated by this journal from the original sketches of individual fractures. The remainder were similarly tabulated by The McConway & Torley Co. All records obtainable from any company are included above.

The total number of couplers, from which some kind of reports of fractures have been received, will be seen to be 71,431. Of these 25,814 do not profess to be completely reported, and are hereafter omitted from these tables. There are, in addition, several lots of some thousands each, from which no reports could be received. Complete returns from the Richmond & Danville, 4,648 couplers, are promised, but are not yet available.

SUMMARY.

Mem. Nos.	Coupler Fractures.	Penna.	Erie.	Penna. Co. etc.	W. N. Y. & P.	P. W. & B.	Total East. Cos.	L. S. & M. S.	N. Y. C. & H. R.	C., C., St. L. & C.	C., R., I. & P.	C., B. & Q.	N. Y. C. & St. L.	Total West. Co.	Grand Total.	Cos. not fully reporting.
1-3	Arm breakages	123	108	12	2	9	254	15	16	2	22	7	4	66	320	7
4-7	Lug "	39	71	8	....	3	121	6	17	3	16	4	1	47	168	3
8-9	Back "	49	95	6	1	1	152	1	5	..	4	2	....	12	164	24
10	Face "	7	5	1	....	....	13	....	....	....	1	....	....	1	14	4
11-16 20	Shank "	97	26	12	8	2	145	6	11	4	25	4	....	50	195	6
17-18	Bracket "	19	.....	....	..	....	19	1	....	..	1	1	....	3	22	....
19	Miscell's "	21	5	1	1	....	28	....	....	..	63	1	....	64	92	1
	Total coupler fractures	355	310	40	12	15	732	29	49	9	132	19	5	243	975	45
	KNUCKLE FRACTURES:															
21-23	Upper lug breakages	160	95	144	83	24	506	97	45	30	172	16	12	372	878	..
24-26	Lower " "	46	20	24	29	3	113	26	32	9	25	1	2	95	208	1
27-31	Both " "	41	20	44	31	5	141	40	30	25	73	12	4	184	325	..
32	Tail "	4	4	1	..	..	9	21	3	4	10	1	..	39	48	..
33	Miscellaneous "	3	..	5	1	..	9	1	.	.	..	..	..	1	10	.
	Total of knuckle fractures	254	139	218	135	32	778	185	110	68	280	30		691	1,469	1
	Couplers in service one year.	8,274	,245	6,572	2,081	1,077	26,249	1,511	1,954	2,297	2,529	592	360	9,243	35,492	

marked effect to accelerate what the data we have lately published shows to be already a rapidly advancing movement.

In presenting records of this magnitude and importance, we are divided between the desire to present them as concisely as possible, so that the main facts may not be lost sight of in a mass of detail, and the desire to give them with such fullness that those desiring to know and study every detail may be able to do so, and so determine for themselves to what extent the deductions given are warranted, or draw further deductions for themselves. As the best available compromise in this dilemma, we summarize in a following article on our editorial page all the main facts as we find them to be, and those desiring to know only these facts may turn to it at once and follow this article no further; while the remainder of this article will be confined to the details of this record, which we shall give in full. The importance of the issue involved, and the novelty and completeness of the record, seem to demand that it should be so given, as the first record of the kind which has ever been available, and probably the last that ever will be available, since it is not likely that such minute care in recording such fractures will be continued much longer on a large scale.

TABLE 5.

JANNEY FREIGHT COUPLER FAILURES BY COMPANIES AND CAUSES, AS SHOWN IN TABLE 4, REDUCED FROM THE ORIGINAL RECORDS TO THE UNIFORM BASIS OF

Failures from each Cause, per 100 Couplers in Service One Year.

Mem. Nos.	Coupler Fractures.	Penna. System.	Erie.	W. N. Y & Pa.	P. W. & B.	Av. Eastern Co.'s.	L., S. & M. S.	N. Y. C. & H. R.	C., C., St. L. & C.	C., R. I. & P.	C., B. & Q.	N.Y.C. & St.L.	Av. Western Co.'s.	General Average.
1	*Arm* off	.87	1.24	.05	.74	.91	.73	.46	.09	.71	1.01	.83	.63	.82
2	" chipped	.03	.07	.05	.09	.05	.26	.26	....	.12	....	.28	.14	.07
3	" cracked	.01	....	....	....	.01	....	.10	....	.04	.17	....	.04	.02
4	*Lugs*, upper off	.11	.49	....	.09	.22	.07	.56	....	.20	.17	.28	.21	.22
	" lower "	.12	.07	....	.19	.10	.20	.05	.04	.08	.34	....	.10	.10
	" both "	.06	.24	....	....	.11	.13	.05	.09	.32	.17	....	.15	.12
	" and back off	.03	.06	....	....	.03	....	.20	....	.04	....	....	.05	.04
8	*Back* split	.33	1.14	.05	....	.55	.07	.26	....	.08	.34	....	.11	.43
9	" out	.04	.01	....	.09	.03	....	....	....	.08	....	....	.02	.03
10	*Face* split	.05	.06	....	....	.05	....	....	....	.04	....		.01	.04
11	*Shank* off at neck	.24	.12	.10	.09	.18	.07	.05	.13	.04	....	....	.07	.15
12	" " shoulder	.34	.12	.24	.10	.25	.33	.41	.04	.67	.51	....	.37	.28
13	" " neck and sh.	.04	....	..	....	.02	....	..	....	.04	....	....	.01	.02
14	" " arm "	.03	.04	....	....	.03	....	....	....	....	....	....	....	.02
15	" through shoulder	....	.04	.05	....	.02	....	.10	....	.04	....	....	.03	.02
16	" at end	....	....	....	....	....	....	....	....	.08	.17	....	.03	.01
20	" bolt pulled thro'.	.08	....	....	....	.05	....	....	....	.12	....	....	.04	.04
17	*Bracket* off	.05	....	....	....	.03	....	....	....	....	.17	....	.01	.02
18	" cracked	.08	....	....	....	.04	.07	....	....	.04	....	....	.02	.04
19	*Miscellaneous*	.15	.06	.04	....	.11	....	....	....	2.48	.17	....	.69	.26
	Tot'l break'gs p. 100 yearly	2.66	3.76	0.58	1.39	2.79	1.93	2.50	0.39	5.22	3.22	1.39	2.63	2.75
	Knuckle Fractures.													
21	*Upper lug* off	1.00	.78	1.53	1.58	1.00	2.63	1.69	1.00	3.32	2.19		2.07	1.28
22	" " chipped	.65	.18	1.68	.46	.58	3.11	.56	.22	2.61	.17	1.39	1.46	.81
23	" " cracked	.40	.19	.77	.19	.35	.73	.05	.09	.87	.34	1.94	.49	.39
24	*Lower lug* off	.30	.19	.58	.19	.29	1.06	1.13	.13	.43		.28	.57	.36
25	" " chipped	.09	.02	.19	.09	.08	.46	.46	.13	.28	.17	....	.29	.13
26	" " cracked	.08	.03	.19	....	.07	.20	.05	.13	.28	....	.28	.16	.09
27	*Both lugs* off	.22	.06	.43	.28	.22	.79	.20	.44	.40	1.52	....	.49	.29
28	" " chipped	.16	.10	.48	....	.16	.20	.46	.31	1.03	.17	.83	.53	.25
29	" " cracked	....	....	....	....	....	.13	....	....	.12	....	....	.05	.02
30	" broken, upper most	.09	.06	.24	.09	.10	.73	.77	.17	.63	.17	....	.51	.20
31	" " lower "	.04	.02	.34	.09	.06	.79	.10	.17	.71	.17	.28	.41	.15
32	*Tail* off	.03	.05	....	....	.03	1.39	.15	.17	.39	.17	....	.42	.14
33	*Miscellaneous*	.06	....	.05	....	.03	.07	....	....	....	....	....	.01	.03
	Total knuckles p. 100 yea'ly	3.18	1.68	6.48	2.97	2.98	12.29	5.62	2.96	11.07	5.07	5.00	7.46	4.14
	Total couplers in service	19,541	7,611	1,665	808	29,625	4,534	2,605	3,938	3,372	1,183	360	15,992	45 617
	Av. months of service	9.1	13	15	16	10.63	4	9	7	9	6	12	6.94	9.34
	Equiv. No. in serv. 1 year.	14,846	8,245	2,081	1,077	26,249	1,511	1,954	2,297	2,529	592	360	9,243	35,492

SUMMARY.

Mem. Nos.	Coupler Fractures.	Penna. System.	Erie.	W. N. Y. & Pa.	P. W. & B.	Average East. Cos.	L. S. & M. S.	N. Y. C. & H. R.	C., C., St. L. & C.	C., R. I. & P.	C., B. & Q.	N. Y. C. & St. L.	Average West. Cos.	General Average.
1-3	Arm breakages	.91	1.31	.10	.83	.97	.99	.82	.09	.87	1.18	1.11	(.71) .90	(.91) .96
4-7	Lug "	.32	.86	....	.28	.46	.40	.86	.13	.64	.68	.28	(.51) .65	(.48) .51
8-9	Back "	.37	1.15	.05	.09	.58	.07	.26	....	.16	.34	....	(.13) .17	(.46) .48
10	Face "	.05	.06	....	....	.05	..	..	....	.04	....	....	(.01) .01	(.04) .04
11-16 20	Shank "	.73	.32	.39	.19	.55	.40	.56	.17	.99	.68	....	(.55) .70	(.54) .57
17-18	Bracket "	.13	....	....	....	.07	.07	....	....	.04	.17	....	(.03) .04	(.06) .06
19	Miscel. "	.15	.06	.04	....	.11	..	....	....	2.48	.17	....	(.69) .16	(.26) .19
	Total per 100 coup., 1 year.	2.66	3.76	.58	1.39	2.79	1.93	2.50	0.39	5.22	3.22	1.39	2.63	2.75

The figures in parentheses above are explained under the next table.

Knuckle Fractures.

21-23	Upper lug breakages	2.05	1.15	3.98	2.23	1.93	6.47	2.30	1.31	6.80	2.70	3.33	4.02	2.48
24-26	Lower " "	.47	.24	.96	.28	.44	1.72	1.04	.39	.99	.17	.56	1.02	.58
27-31	Both " "	.57	.24	1.49	.46	.54	2.64	1.53	1.09	2.89	2.03	1.11	1.99	.91
32	Tail " "	.03	.05	....	....	.03	1.39	.15	.17	.39	.17	....	.42	.14
33	Miscel. " "	.06	....	.05	....	.03	.07	....	....	....	....	....	.01	.03
	Total per 100 coup. yearly.	3.18	1.68	6.48	2.97	2.97	12.29	5.62	2.96	11.07	5.07	5.00	7.46	4.14
	Couplers in service 1 year.	14,846	8,245	2,081	1,077	26,249	1,511	1,954	2,297	2,529	592	360	9,243	35,492

N. B.— *The average months of service* for each lot of couplers were estimated by this journal from general records, without consultation with the manufacturers or companies, for lack of time, and are believed and intended to be somewhat *underrated* in every case. In the case of the Pennsylvania they have since been ascertained to be underrated considerably.

The several companies have different methods of keeping these records. Some, like the New York Central, record each fracture on large blue-print drawings of the couplers; some, like the Chicago, Burlington & Quincy, take photographs of the broken couplers, setting them up in a row on a plank, like dogs at a bench show. Some merely send the broken couplers to the manufacturers, preserving records of their own and of course the aggregates, but leaving to the manufacturers the task of classifying them in detail. This the McConway & Torley Co. do on small blanks headed by cuts of the coupler and knuckle from every point of view, like those of Figs. 7 to 33. A separate blank is used for each fracture. All of the records here given have been thus independently recorded in detail.

These individual records we have used, as stated, to classify for ourselves the breakages of two of the eleven companies given, as follows, the returns from them not having been ready when we were first furnished these details:

New York Central & Hudson River...2,605 couplers
Chicago, Burlington & Quincy.....1,183 couplers

For the remaining nine roads (as also for five others making partial reports only), we were furnished with a classified list similar to Table 3, for each of the 33 different kinds of breakages below given, showing the number of fractures of each kind reported on each road. These nine companies were as follows:

Pennsylvania	8,274 couplers.
Penna. Co., and Pittsburg, Cincinnati & St. Louis	11,267 "
New York, Lake Erie & Western	7,611 "
Western New York & Pennsylvania	1,665 "
Philadelphia, Wilmington & Baltimore	808 "
Lake Shore & Michigan Southern	4,534 "
Cleveland, Columbus, St. Louis & Chicago	3,938 "
Chicago, Rock Island & Pacific	3,372 "
New York, Chicago & St. Louis	360 "

This makes a total of 45,617 couplers. The returns of the Richmond & Danville, when received, will

TABLE 6.

CONDENSATION AND REARRANGEMENT OF THE DATA SHOWN IN THE SUMMARY OF TABLE 5 WITH PERCENTAGES, BEING THE FIGURES FROM WHICH THE ACCOMPANYING DIAGRAMS WERE CONSTRUCTED.

Coupler Fractures per 100 Couplers in Service One Year.

Location of Fracture.	GENERAL AVERAGES.			PARTICULAR COMPANIES.					
	Eastern.	Western.	General Average.	N. Y. C. & H. R.	C., B. & Q	Pennsylvania System.	Erie.	L. S. & M. S.	Five Others Remaining.
Arm	.97	.90	.96	.82	1.18	.91	1.31	.99	.69
Lugs	.46	.65	.51	.86	.68	.32	.86	.40	.42
Back	.58	.17	.48	.26	.34	.37	1.15	.07	.10
Face	.05	.01	.04	....	....	.05	.06	....	.01
Shank	.55	.70	57	.56	.68	.73	.32	.40	.69
Bracket	.07	.04	.06	....	.17	.13	....	.07	.02
Miscellaneous	.11	.16	.13	....	.17	.15	.03	....	.15
Total couplers	2.79	2.63	2.75	2.50	3.22	2.66	3.76	1.93	2.08
Knuckle Fractures per 100 Couplers in Service One Year.									
Upper Lug	1.93	4.02	2.48	2.30	2.70	2.05	1.15	6.47	3.84
Lower Lug	.44	1.02	.58	1.64	.17	.47	.24	1.72	.71
Both Lugs	.54	1.99	.91	1.53	2.03	.57	.24	2.64	1.65
Tail	.03	.42	.14	.15	.17	.03	.05	1.39	.17
Miscellaneous	.03	.01	.03	....	....	.06	....	.07	.02
Total Knuckles	2.97	7.46	4.14	5.62	5.07	3.18	1.68	12.29	6.39
Equated No. Couplers	23,249	9,243	35,492	1,954	592	14,846	8,245	1,511	8,344
Percentage of Various Kinds of Coupler Fractures.									
Arm	34.8	35.1	35.0	32.8	36.8	34.3	34.9	51.2	33.2
Lugs	16.3	24.9	17.9	34.4	21.0	11.9	22.8	20.7	20.2
Back	20.9	6.4	17.9	10.4	10.7	13.9	30.6	3.7	4.8
Face	1.8	0.4	1.4	....	....	2.0	1.6	....	0.5
Shank	19.7	26.8	21.4	22.4	21.1	27.4	8.5	20.7	33.1
Bracket	2.8	1.5	2.4	....	5.2	4.8	....	3.7	1.0
Miscellaneous	3.7	4.9	4.0	....	5.2	5.7	1.6	....	7.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Percentage of Various Kinds of Knuckle Fractures.									
Upper Lug	65.0	53.8	59.8	40.9	53.4	64.4	68.4	52.6	60.1
Lower Lug	14.5	13.8	14.1	29.2	3.3	14.9	14.3	14.0	11.1
Both Lugs	18.1	26.6	22.3	27.2	40.0	18.0	14.3	21.5	25.8
Tail	1.2	5.7	3.2	2.7	3.3	1.0	3.0	11.3	2.7
Miscellaneous	1.2	0.1	0.6	....	....	1.7	....	0.6	0.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

N. B.—In deducing this table from Tables 4 and 5 the great excess of "miscellaneous" (*i. e.*, not fully described) fractures in the C., R. I. & P. report was distributed *pro rata* among the specific causes of failure. This was done to avoid a deceptive disturbance of the percentages of the "five remaining companies," and of the Western and General Average as well; the C., R. I. & P. report showing 63 out of 132 fractures as "miscellaneous," or about 56 more than a fair proportion. This correction was made as follows: The tables were first computed as per the face of the returns, giving the general averages shown in parentheses in the last two columns of the summary to Table 5. The probable fair maximum for Miscellaneous was then assumed as given in black figures in those columns (viz.: .16 instead of .69, and .13 instead of .26), and the excess distributed in exact proportion to the specific items of each column. The columns referred to in Table 5 will show how this was done, and also the necessity for doing so to make the totals tell the truth. This was the only correction of returns made in any of the tables. It does not affect the aggregate of fractures, but only their distribution.

add 4,648 more. Of these the 1,183 of the C., B. & Q. were not included in the data turned over to us by the manufacturers, but have been added by us since.

The data first turned over to us were accompanied by the summaries shown in Tables 1 and 2; each of the kinds of breakage there listed by "Memorandum Numbers," 1 to 33, being shown on the accompanying Figs. 1 to 32, the numbers of the cuts corresponding with the memo. numbers. The summaries of Tables 1 and 2 were accompanied by 33 detail sheets, as stated, of the first of which Table 3 is a sample.

A very considerable irregularity in the percentage of fractures on the different roads will be seen on examining Table 3. In part this is easily explainable, some roads having many more foreign couplers on their own lines than they send away, and *vice versa*; and doubtless some inspecting more closely than others. In part, it might naturally result from slight shades of difference in the quality of different lots of couplers. But it is obvious that the most important single cause for variation was that the couplers on the different roads had been in service for very different lengths of time, some for much more than a year, some for a few months only.

Simply for our own satisfaction, therefore, we caused an estimate to be made from the fairly full records of this office of the AVERAGE MONTHS OF SERVICE of the couplers of each road, with a view to reducing the records to the uniform basis of *fractures from each cause and in total, per hundred couplers in service one year.* We regret that we did not realize in the beginning the importance which this record would assume, and contemplate the possibility of publishing it in full, as here given. We should then have taken measures to ascertain from the several companies and the manufacturers the exact figures for average months of service. We did not do this, however, but made our own estimate, as stated, and as shown at the bottom of Tables 4 and 5. This estimate was intended to be, and we believe is, a conservative *under estimate* of the actual period of service in each case. It was made by another hand than the compiler of the remainder of the statistics and writer of this article, *and has not been changed in any case from the original estimate.* There has, therefore, been in no single case any change of the records of Tables 5 and 6, on which the following diagrams are based, except to correct one or two trifling numerical errors.

Since compiling the statistics and constructing the diagram we have ascertained positively as respects nearly 40 per cent. of the couplers listed that their average period of service was very considerably underrated, as below more fully noted. Of others we were satisfied from the first that the allowed service must be too small. An even quarter of the C., B. & Q. knuckle fractures, for example, were of a kind which we knew were not used on the road at all. To change one estimate without changing all, however, would have been inconsistent.

It was also determined to divide the 11 roads into two lots of "Eastern" and "Western" roads, and determine separate averages of each. Two inconsistencies in this classification require notice: The Pennsylvania Co. and the P., C. & St. L. were included with the Pennsylvania in the "Eastern" roads, in order not to separate two parts of the same system, which obviously should be taken together to show the real facts for that great system as a whole. On the other hand, the New York Central is with much less reason included with the "Western" roads. This was done because the N. Y. C. returns were the last received, after the first part of the table was computed. Partly to save recomputing it, partly not to separate the N. Y. C. from the Lake Shore, but partly to decrease the inequality in the total number of couplers averaged in the two halves of the table, the 2,605 couplers of the N. Y. C. were added in with the "Western," making that represent 15,992 couplers against 29,625 "Eastern" couplers. It made no sensible difference with either average to which side of the table the N. Y. C. was added, as Table 6 and the diagram of coupler breakage will at once show. Therefore, there is not even room for suspicion that there was any ulterior purpose in this plain misclassification. Even now, with the N. Y. C. added to the weaker side, the "equated" number of couplers (equated for one year's service) is 23,249 against 9,243 so-called "Western" couplers, the longer service of the Western couplers increasing the disproportion in actual numbers.

THE BASIS OF EQUALIZATION.

The actual number of couplers in service on each road was "equated" to bring it to the uniform basis of one year's service, as follows: For 6 mos. actual service half the number was taken; for 4 mos. one-third the number; for 16 mos. the actual number increased by one third, etc. It is apparent that this is not a precisely fair basis of comparison. Couplers in service 4 mos. will naturally show much more than one-third of the breakages due to 12 mos. service, and the first year's service should naturally show many more breakages than the second year's service, for the reason that all the couplers which are in any way defective are likely to fracture early. The first year's and first few months' breakages are therefore likely to be abnormally great. On the other hand, there must in the end come a time, as a lot of couplers approaches the limit of its life, whatever that limit may be, when the "death-rate" will again increase. The death-rate of couplers will naturally be like the death-rate of men, largest at the two extremes of infancy and old age, much smaller in the intermediate period.

But as all these couplers are comparatively young the comparison is not greatly affected by this basis of equalization, and it is the only one possible. Moreover, few couplers so defective as to break readily are likely to pass the manufacturers' inspection, and the exceptionally severe blows which cause most breakages are likely to be about so many per month.

Some light is shed upon this subject by the important statement appended to Tables 1 and 4, as follows: All couplers which appear to have failed from defect under fair usage are replaced by a new one by the manufacturers free of charge. Those which fail under unfair usage without visible cause are not so replaced. So far, out of 943 broken couplers, 640, or 68 per cent. have been so replaced by the makers, leaving 313, or 32 per cent., which have failed without discoverable excuse for doing so.

The proportion of the latter, per 100 in service, we may reasonably expect to somewhat increase from year to year as the couplers grow old. On the other hand the proportion of the former, which fail from some defect, we may reasonably expect to very rapidly decrease. As this covers over two-thirds of all fractures reported, it is obvious that as a whole the showing obtained from these comparatively young couplers is likely to be much worse than a similar record for their ensuing year of life would show.

A single correction of the returns only became necessary in constructing Table 6 and the accompanying diagrams. The C., R I. & P. report covered an enormous excess of "miscellaneous" coupler fractures, nearly half of the whole, and two-thirds of the whole number of "miscellaneous" reported, although the C. R. I. & P. has only 7 per cent. of the couplers. It is obvious that this must have arisen merely from failure to describe all the fractures fully, and to avoid throwing out all the averages as well, the excess of "miscellaneous" percentage thus caused was distributed in exact *pro rata* to the other causes of fracture, as explained under Table 6, and shown in detail in the last two columns of Table 5.

THE COUPLER DIAGRAM.

From data thus deduced and collected in Table 6 the two large diagrams of breakages were constructed. Considering that the division into Eastern and Western roads was a purely arbitrary one, the agreement between the two is truly remarkable. It seems unnecessary to discuss it in detail. It speaks for itself, not only the aggregates but the distribution of the fractures being almost identical, the one seeming exception being a difference in the proportion of back failures, which is due to a single lot of bad backs on the Erie, as below noted. Here we desire to call attention to one fact, however, which is very apparent throughout the diagram—the evenness of the distribution of the fractures to the various parts of the coupler. It is obvious that when once every part of such a device has been made of equal strength, and the aggregate of breakages is moderate, not much more improvement in it is possible. It may get better usage hereafter, and so get fewer breakages, or it may (conceivably) be made hereafter of some stronger material and so be lightened throughout; or it may (conceivably) be made heavier throughout, and so the aggregate of breakages further decreased. We show, on another page, that this would be more inexpedient, as costing much more than it would come to, even if it would effect the end, which, for practical reasons, is more than doubtful. The main lines of the design are plainly about right, and it would be absurd to hope for further improvement in them, since there is no particular part of the coupler proper which shows any need of strengthening.

The fourth column of the coupler diagram shows the New York Central, whose original records of individual fractures we classified for ourselves. Although there were only 49 of these fractures, it will be seen that the aggregate per 100 couplers in service almost precisely corresponds with the general average, and the percentage of arm and shank fractures also closely corresponds. There would appear to be rather many lug and rather few back fractures, but then the totals of these fracture were only 16 and 5 (Table 4), *and among these were* 4 "*both lugs and back off.*" It is obviously a matter of choice whether to classify these under "lugs" or under "back." Had we put them under "back," as we fancy has been the general custom, and perhaps more properly, the respective totals would have been 12 and 9, instead of 16 and 5, and we show by a dotted line on the diagram, otherwise unexplained, where this would bring the division line between lugs and back, showing an agreement so close with the general average that we almost hesitate to call attention to it.

The next column, that of the C., B. & Q., is even more surprising. It is deduced from *only nineteen fractures*, also classified by us from the original records, photographs of the broken couplers. The photographs were accompanied by the statement, quoted on our editorial page, to the effect that they were the collections of the past six months from "in the neighborhood of 500 cars." Our records showing, perhaps erroneously, 1,183 couplers in use, we credited that number with only six months service, although it was known to us, as above noted, that some of the fractures would be likely to include some couplers broken more than six months before, as also many from exchange roads, from which the C., B. & Q. probably has been receiving more than it sent away. Remembering also that the first six months service was likely to be particularly severe on couplers, we hardly expected this small lot of fractures to check very closely with the rest, feeling on the one hand that it might show unduly high, and on the other that so small a list might well prove to be an unduly "startling one of goodness," as is suggested in the letter quoted elsewhere.

The result, however, is before the reader in the fifth column of the coupler diagram, unrevised from the original computation, as we feel bound again to assert, in view of its astonishingly close comparison, both in aggregate and in detail, with the general average.

Next comes the great Pennsylvania system, with 14,846 couplers in service one year, or 42 per cent. of the whole, and 19,541 couplers actually in service. The coincidence of this with the general average of which it forms so large a part, while amazingly close, is not nearly so surprising as the less exact agreement of the C., B. & Q. We have learned since this diagram was prepared that we did injustice to this record in one respect, in greatly under-rating the average months of service of the couplers. On the Pennsylvania R. R., for whose couplers we allowed only 12 months average, the actual average service was 17.7 months, or 47 per cent. more. For the Pennsylvania Co. and P. C. &. St. L. couplers, to which we credited only 7 months service, the actual average was 10.9 months, or 56 per cent. more. The true "equated" number of couplers for one year's service should therefore have been nearly 50 per cent. larger than we give it, and consequently the fractures per cent. only two-thirds as many, or 1.78 instead of 2.66, or slightly less even than the L. S. & M. S. The general average would by this change be reduced from 2.75 per cent. to 2.38 per cent. and the eastern average only, from 2.79 per cent. to 2.29 per cent. By dotting lines on the diagram it will be seen how these changes would affect it.

THE SERVICE RECORD OF M. C. B. STANDARD JANNEY COUPLERS.

Diagrams Showing the Various Kinds of Knuckle Breakages, which are Separately Classified, with the Number of Each which have Occurred to Date, as Shown in Detail in Tables 4, 5, and 6.

[The letters E. and W. at right of cuts signify the Eastern and Western aggregates or averages.]

UPPER LUGS.

No. E. 262, W. 192; 454
P. c. y'rly, 1.00, 2.07; 1.28

Fig. 21. Upper Lug Off.

No. E. 151, W. 135; 286
P.c. y'rly, 0.58, 1.46; 0.81

Fig. 22. Upper Lug Chipped.

No. E. 93, W. 45; 138
P.c. y'rly, 0.35, 0.49; 0.39

Fig. 23. Upper Lug Cracked.

Total upper lugs..... E. 506, W. 372; 878
Per cent. yearly 1.93, 4.02; 2.48

LOWER LUGS.

No. E. 75, W. 53; 128
P.c. y'rly, 0.29, 0.57; 0.36

Fig. 24. Lower Lug off.

No. E. 20, W. 27; 47
P.c. y'rly, 0.08, 0.29; 0.13

Fig 25. Lower Lug Chipped.

No. E. 18, W. 15; 33
P.c. y'rly, 0.07, 0.16; 0.09

Fig. 26. Lower Lug Cracked.

Total lower lugs..... E. 113, W. 95; 208
Per cent. yearly..... 0.44, 1.02; 0.58

BOTH LUGS.

No. E. 58, W. 45; 103
P.c. y'rly, 0.22, 0.49; 0.29

Fig. 27. Both Lugs Off.

No. E. 41, W. 49; 90
P.c. y'rly, 0.16 0.53; 0.2

Fig 28. Both Lugs Chipped.

No. E. 1, W. 5; 6
P.c. y'rly, —, 0.05; 0.02

Fig. 29. Both Lugs Cracked.

No. E. 25; W. 47; 72
P.c. y'rly, 0.10, 0.51; 0.29

Fig. 30. Upper Off; Lower Chipped.

No. E. 16, W. 38; 54
P.c. y'rly, 0.06, 0.41; 0.15

Fig. 31. Lower Off; Upper Chipped.

Total both lugs..... E. 141, W. 184; 325
Per cent. yearly..... 0.54, 1.99; 0.91

TAIL.

No. E. 9, W. 30; 39
P.c. y'rly, 0.03, 0.42; 0.14

Fig. 32. Tail Off.

But as the same error of underestimate of length of service is believed to run through the whole of the diagram, as already explained, although we hope in less degree, the comparison is about fair; while it seems quite possible from the records (Table 4) that the western Pennsylvania lines have not cleaned up and reported their fractures quite so closely as they might, no longer keeping any records of their own. This would cause some error in the other direction, although it is natural from operating conditions that the Pennsylvania should return somewhat more fractures proportionately. The one thing which seems certain is that our diagram does not overstate, but rather understates, the Pennsylvania experience as a whole.

The next column is the Erie, which shows pretty heavy coupler breakages (3.76 per 100 in service a year), the heaviest of all. We need not search far for a ia explanation. It has a great excess of back fractures, and referring to Table 4 we find that these are all (*i. e.*, 94 out of 95) *split backs*, being nearly *two-thirds* of all the fractures of this kind reported, although the Erie has only *one-sixth* of the total couplers reported. It has therefore, about four times its normal proportion of bad backs, *i. e.*, instead of having 1.15 split backs per 100 in service a year, it ought to have only 0.30 or 0.85 less. The Erie, evidently, got a quite exceptionally bad lot in this respect, in 80 of its couplers having thus failed.

[Since this article was written we learn that nearly all these split backs occurred in a lot of couplers which were especially defective.]

Deducting this above deduced 0.85 from the Erie's record of 3.76 per cent., we obtain 2.91 per cent., bringing the Erie down to quite as close agreement with the rest as is healthy. The effect of this change is indicated by two otherwise unexplained dotted lines on the diagram. [N. B.—This Erie excess of bad backs affects also the Eastern and the general average. The Western average, and the N. Y. Central and Pennsylvania, show better the normal proportion of bad backs.]

The next column of the coupler diagram, for the Lake Shore & Michigan Southern, shows very few coupler fractures, but it should be especially noted that *there are particularly few lug and back fractures.* Referring to the knuckle diagram, however, it will be seen that the Lake Shore has abnormally many knuckle fractures. If the details of both diagrams be carefully studied for a few minutes, we think the reader will agree with us that men have been hung, by Judge Lynch at least, on weaker circumstantial evidence than the diagrams afford, that 8 or 10 coupler-lug fractures have been lumped in by careless returns with the 163 knuckle-lug fractures of that road. The coupler "arm" fractures of the Lake Shore are about normal, and adding 10 more to its coupler fractures increases them from 29 to 39, making its total coupler fractures per 100 in service 2.58 instead of 1.93, or close to the general average of 2.75 per cent. The effect of this change also is indicated on the diagram by an otherwise unexplained dotted line. If we consider 12 instead of 10 coupler-lug fractures to have been thus misclassified as knuckle-lugs, the Lake Shore total per cent. becomes exactly that of the general average, as its arm-fracture per cent. is.

As for the last column of the diagram, showing the five remaining roads together, we attach no great weight to it. The roads may be studied in detail in Tables 4 and 5. The P., W. & B. shows remarkably few fractures, yet we incline to believe its report is correct and full. The same is less decidedly true of the W. N. Y. & P. The C., C., St. L. & C. returns seemingly err by omissions, only nine broken couplers being returned from 4,000 cars, in use (by our estimate) seven months. This is too good to be true. The same is less clearly true of the N. Y., C. & St. L. returns of only five couplers from its small number of 300. On the other hand, the Rock Island return shows more than the average of both coupler and knuckle fractures, the only road which does show an excess for both. We should be more impressed by this if there were not the important imperfection above noted in its return, nearly half its coupler fractures (63 out of 132) being returned merely as "miscellaneous;" i. e., not classified at all. Its shank or body breakages are a much larger proportion than on any other road in the list, indicating that it may have had some exceptionally imperfect castings, and that there may be some partial cause for its many "miscellaneous" breaks; but we are inclined to think that the true explanation is, that the real record is for a greater number of couplers than 3,372 in service nine months. Its very heavy knuckle breakages, and quite an abnormal percentage of "both lugs broken" (see Table 5), also suggests, *if it does not prove*, that the Rock Island couplers have had pretty hard usage.

As a whole, the last miscellaneous column of the coupler diagram agrees quite well enough with the rest to serve as confirmatory evidence. There is at most only exception enough to prove the rule.

THE KNUCKLE DIAGRAM.

Three things are immediately evident from this diagram; first, that the number of fractures per hundred in service one year is no longer uniform but very unequal; secondly, that the number is much larger than of coupler fractures; thirdly, that *nearly all the fractures are in the lugs.* The last is, perhaps, the most important and significant indication of the diagram. The very trifling proportion of tail and miscellaneous fractures is brought out with especial clearness in the diagram of percentages underneath the main diagram.

Now, the knuckle lugs are a quite different matter from the coupler lugs. The last are an essential feature of the coupler itself, and if they showed any special tendency to fracture it would be an alarming matter. The knuckle lugs, on the contrary, like the slot which forms and separates them, are a merely provisional feature, designed to permit of coupling with the old style link and pin drawbars. So soon as that style of drawbar has passed out of use, as it will almost immediately after such cars are refused interchange facilities, all necessity for knuckle lugs will disappear, and the coupling end of the knuckle may be then made solid.

In the mean time the knuckle lugs cannot be made stronger, because the pin hole and slot cannot be made smaller, nor the knuckle itself thicker. It is therefore of interest to see, as we may from the diagram, that the knuckle breakages are not a serious matter in any case, and that where they run above a very moderate average the cause may be directly traced to extra rough usage, which disappears with longer experience with the couplers and a larger number in service.

This seems to be shown conclusively by the varying proportions of fractures of upper lug, lower lug, and both lugs. The knuckle, we need not say, has to sustain directly the impact of the common "bull nose," and it is chiefly from these that it has much liability to injury. In coupling with its own kind, the knuckle simply revolves, and is not subjected so impact strain until the act of coupling is complete. It may then, of course, give and take as hard a blow in foot-pounds as from a "bull-nose" (in fact a harder blow because there is no one standing between the cars to couple them to cause caution); but it is from a surface formed like itself, and so a diffused rather than concentrated blow. As a matter of fact, we believe broken knuckle lugs in coupling M. C. B. couplers together are comparatively rare.

Laboratory tests in a testing machine indicate the tail to be the weakest point of the coupler under a dead pull, *i. e.*, the one which gives way first; but that this is not the case in practice, and only happens as a rare exception, the diagram clearly shows. Out of 1,469 reported knuckle fractures but 48 tails have failed, or 1 for every 1,000 couplers in service.

Most of the knuckle fractures are of one lug only, and of these about four-fifths are upper lug fractures. This is explained by the fact that there is usually a slight droop to the ends of freight cars, enough to cause the upper lug to sustain the most impact. Only under exceptional conditions will the lower lug sustain it, and only under very heavy blows are both lugs likely to be fractured.

It is evident, therefore, that where knuckle fractures are especially frequent, if this be due to exceptionally hard usage and not to defects of material, we should expect to find the *proportion* of both-lug fractures increased, as well as the absolute number of all fractures. This is very notably the case.

Contrast, for example, the average of the Western roads and the average of the Eastern roads. The Western roads have more than twice as many knuckle fractures per 100 couplers in service one year (7.46 against 2.97), and they also have nearly twice as large a *proportion* of both-lug fractures (26⅛ per cent. of all knuckle fractures against 18 per cent. on the Eastern roads), making the total number of both-lug fractures per 100 in service about 4 times as great (1.99 against 0.54).

Running right across the diagram we find in every column where the total fractures are high an abnormal proportion of both-lug fractures, as in columns 2, 4, 5, 8 and 9. The most fractures of all occur on the C., R. I. & P. (see Table 5). It also has the largest percentage of both-lug fractures, no less than 26 per cent. The next worst is the Lake Shore, which has so many knuckle fractures that we had to reduce its column to half scale, as we should have had to do for the Rock Island had we shown it separately. The Lake Shore has 22 per cent. of knuckle fractures, and a quite abnormal list of tail fractures in addition.

The C., B. & Q. shows no less than 38 per cent. of both-lug fractures, and the New York Central 27 per cent. On the other hand, the Pennsylvania system and the Erie, with far more cars in service than all the other roads put together, show only about 15 per cent. of both-lug fractures, the general Eastern average being only 18 per cent. Even the little roads whose returns we have spoken of as dubious, show in all cases a small per cent. of both-lug fractures, with few total breakages, and *vice versa.*

Stronger circumstantial evidence could hardly be that the normal knuckle failures under present conditions are the very moderate proportion of the eastern roads, about 2¾ yearly per 100 in service, and that the excessive proportions of the western roads and the Vanderbilt lines, rising to 6, 8, 10 and 12 per 100, are due to unduly rough usage, solely. In part this is unavoidable; an incident of the transition period, on which these roads have not advanced so far as the other lines; but in part it is probably avoidable. When tens of thousands of couplers are making such good records as are shown, there can hardly be a sound excuse for fracturing couplers at the higher rates shown, nor do we believe it will continue long.

The diagram also affords reasonable hope, in fact makes it quite certain, that as the proportions of M. C. B. couplers in use increases, the number of knuckle fractures will continue to decrease down to very small proportions, even without abolishing altogether the lugs and slot for link coupling, which would end them altogether. As the lugs are practically the only part which breaks, and as they are broken for the most part only by impact with the common link drawbar, as the latter becomes rarer the knuckle fractures must inevitably decrease *pro rata.* It seems to us that the diagram bears clear evidence that the knuckle failures per 100 in service will eventually be rather under than over one per year.

But even if no better result is ever attained than is distinctly indicated by the face of the diagram, about two and a half knuckle fractures yearly, the tax in this respect will be a very small one. The knuckle weighs about 40 lbs., and costs, new, $4. The manufacturers are now returning one sound knuckle for every two broken ones, regardless of cause of breakage, and are likely to continue to do so. This will make the total cost of knuckles $5 per 100 couplers yearly, or 10 cents per car, which is likely to fall to five cents, and even, in the case of companies like the Rock Island and Lake Shore (at present), breaking 10 or more knuckles per year, would only be 40 cents per car. How this compares with present expenditures is shown on our editorial page.

It is notable that bending of knuckles without breakage occurs so rarely that it is not deemed worthy of separate classification. Such instances, which must sometime occur, are included in the miscellaneous class (item 33), which averages only 6-10 of 1 per cent.

There are various other details of this statement which may otherwise escape the attention of the reader, and to which we might give a word of comment, but our space is already more encroached on than would have been permissible for any less important record; and the interested reader may be left to examine into further details for himself. We discuss on our editorial page the financial and humanitarian aspect of this statement, and in the meantime will only express our great satisfaction, as well as our great surprise, that it is already possible to put forth a statement so conclusive in itself and so entirely satisfactory. The makers and the country alike are to be congratulated that such good results are already obtained.

DIAGRAMS

SHOWING THE SERVICE RECORD OF ALL

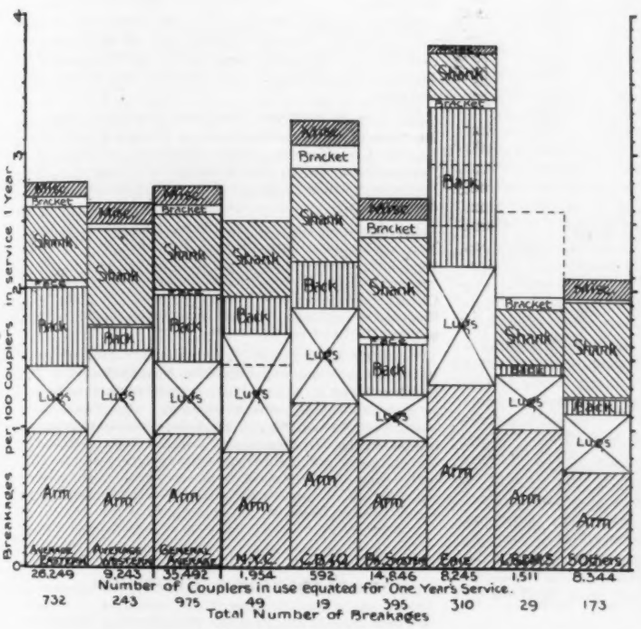
M. C. B. STANDARD JANNEY COUPLERS SO FAR

MANUFACTURED.

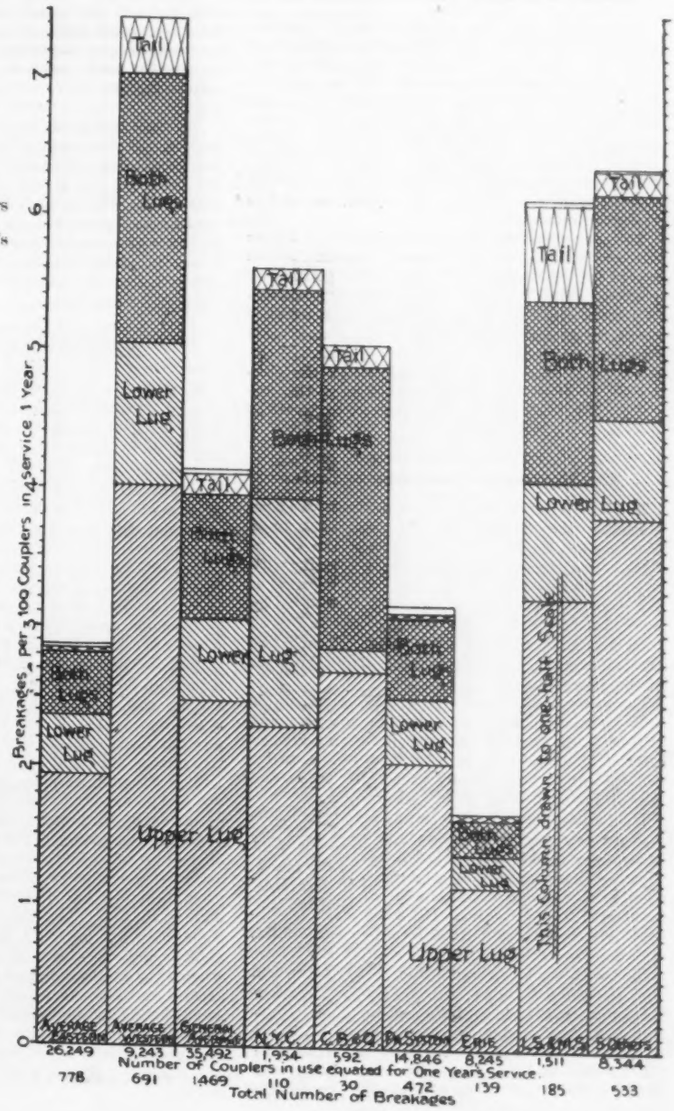
[So far as any full reports are obtainable, viz., from a total of 45,617 couplers of an average service computed at 9.34 months ; = 35,492 couplers for one year's service.]

[Reduced by this Journal from the Original Records of Individual Fractures to the Uniform Basis of

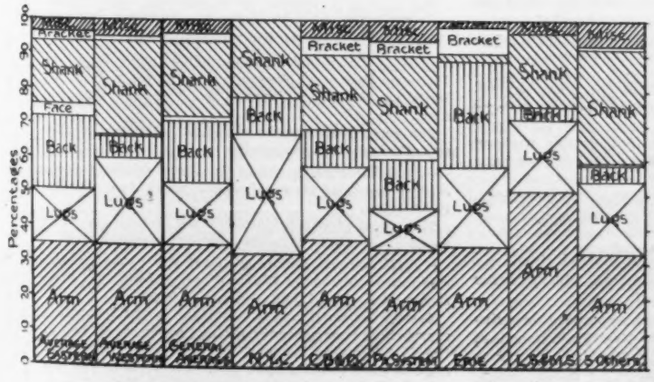
COUPLER AND COUPLER KNUCKLE FAILURES PER 100 COUPLERS IN SERVICE ONE YEAR.


Breakages per 100 Couplers in service 1 Year
Arm
Lugs
Back
Face
Shank
Bracket
Number of Couplers in use equated for One Year's Service.
Total Number of Breakages
26,249 9,243 35,492 1,954 592 14,846 8,245 1,511 8,344
732 243 975 49 19 395 310 29 173

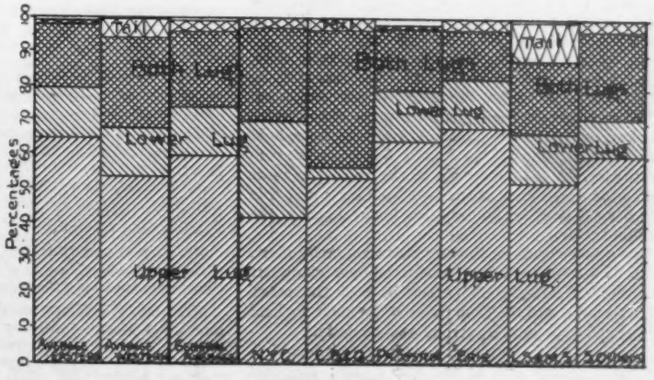
COUPLER FRACTURES.


Breakages per 100 Couplers in service 1 Year
Tail
Both Lugs
Lower Lug
Upper Lug
This Column drawn to one half Scale.
Number of Couplers in use equated for One Year's Service.
Total Number of Breakages
26,249 9,243 35,492 1,954 592 14,846 8,245 1,511 8,344
778 691 1469 110 30 472 139 185 533

KNUCKLE FRACTURES.



COUPLER FRACTURES.



KNUCKLE FRACTURES.

DIAGRAMS SHOWING THE PERCENTAGE OF THE VARIOUS KINDS OF COUPLER AND KNUCKLE FAILURES OF ALL JANNEY COUPLERS.

Electric Lighting of Inclined Railways.

In an article in the *Schweizerische Bauzeitung*, Prof. DENZLER gives some notes on the behavior of the electric plant which operates the inclined railway and furnishes the current for the lamps on the Burgenstock, on the Lake of Luzerne. He states that the probability of the disturbance of a line depends not only on its length, but also on the difference in potential at the primary machine, the difference in elevation of the portions of the conductor, and the proximity of the line to a place exposed to violent thunder storms.

The effect of a difference in height and a difference of potential at the primary machine is well marked at the Burgenstock, where the generating plant is 1,640 ft. lower than the secondary machines. When the upper station is enveloped in a thunder cloud, the discharges are much stronger and more frequent than when the clouds are higher. If the storm takes place during the day, when the electricity is employed for the railway only, the discharges are much less powerful than at night when the lamps are in the circuit.

The Montmartre Reservoirs of Paris.

In a late number *Le Genie Civil* illustrates a remarkable three-storied reservoir just built upon Montmartre, the highest point within the City of Paris. The purpose is to supply the whole city with water from this high level. The total capacity of the reservoirs is 11,000 c. m., which is raised up by works located at the foot of the hill, and is drawn from springs through the distribution pipes of the Dhuis Reservoir, and the river water from the pipes of the Bercy works.

The reservoir covers an area of 2,300 sq. m., and is built up in three separate stories in one part and two stories in another. The two lower stories store 4,800 cu. m. of water at an elevation of 127.3 m. above city datum; the second story holds 4,200 cu. m. and the third story 2,000 cu. m. of spring water.

The foundation is yellow sand, very permeable and unstable, and great precautions were necessary to insure against landslips. Briefly stated, the walls of masonry are founded on a concrete base 12.5 ft. deep, pierced in one direction with drainage galleries about 7 ft. in diameter. The outer walls are exceedingly massive, and are faced with rough ashlar, with cut-stone trimmings. The several stories are arched with brick, springing from heavy piers, and with the spandrils filled with concrete. The reservoirs were built in 1887-89 from plans of M. GOURNAT, C. E., and under the directions of M. BECHMANN, C. E. The approximate cost was as follows: Earthworks and masonry, $200,000; piping, etc., $6,000, a sum that seems remarkably low for the amount and character of the work done.

100-Ton Crane at Belfast, Ireland.

A powerful derrick-crane has recently been constructed at the Britannia Works, Birkenhead, England, and erected at the Alexandra Graving Dock, at Belfast. It will lift and swing 100 tons at 50 ft. radius; but the range of the jib can be varied from 30 ft. to 80 ft. radius, with loads as follows: 100 tons at 50 ft., 80 tons at 60 ft and 60 tons at 70 ft.

The mast of the crane is made up of two girders, approaching each other at the top, connected by cross braces, and with the engines between them. The bottom of the mast is a steel pivot 15 ins. in diameter, resting on steel phosphor-bronze discs, held on a massive central step bolted down to the concrete pier. A 15-in. steel pin at the top of the mast takes the upper ends of the two back legs; and this pin has a T head for holding the lower block of the luffing tackle.

The crane stands on three massive concrete piers, with the two back legs connected by a triangular framing of box-girders to the base of the mast. This framing and the base plate of the mast is held to the concrete piers by strong anchor bolts.

The jib is 100 ft. long and is made of two box-girders merging into one at the upper end; diagonal bracing connects the lower girders. There are two sets of pulleys at the upper end; the upper one for loads up to 20 tons, and the lower set of four pullies for the main load of 100 tons. All these pullies are made of steel and are 5 ft. in diameter, with split bosses and gun-metal bushes. The main hoisting block has three such pullies.

The steel wire hoisting rope is 7 ins. in circumference, made of six strands, each having a breaking strain of over 30 tons. This rope passes down to a grooved barrel on the hoisting engine. The gear for turning the mast consists of a pair of pinions gearing into an annular steel rack bolted down to the central pier.

The main lifting blocks give a clear hoist of 90 ft., and the specified speed of lift is as follows: 100 tons, 4 ft. per minute; 50 tons, 8 ft. per minute; 25 tons, 16 ft. and 12½ tons at 32 ft. per minute. But at the official trial 100 tons were lifted 8 ft. in 75 seconds with a steam pressure in boiler of but 50 lbs. per sq. in; and a load of 120 tons was lifted at the rate of 5 ft. per minute at a radius of 50 ft. with a boiler pressure of 45 lbs. We are indebted to *Engineering* for the data for these notes.

Safety in Electric Lighting.

Sir WILLIAM THOMSON, in *North American Review*, says that—We are forced to conclude that in laying down these regulations, and in arranging for careful inspection to secure their fulfillment as far as practicable, the advisers of the British Board of Trade felt that the danger from high-pressure overhead wires could not be absolutely annulled. This view is confirmed by the fact that in most or all cases in which provisional orders under the Electric-Lighting Act of 1888 have been granted to companies for the electric lighting of cities or districts of cities, it has been stipulated that the conductors shall be altogether under ground, except in cases in which aerial wires have already been placed and brought into action, and that even in these cases the conductors, if for high pressure supply, shall be removed from the air and replaced by underground conductors within two years. It may be considered, indeed, as now definitely resolved that the distribution of electric energy for light and power in towns of the United Kingdom shall be by underground conductors, and plans for carrying this into effect safely and economically are engaging the anxious consideration of electrical engineers. The telegraphic department of the Post-office has already replaced nearly all the aerial telegraph wires of the larger cities by underground conductors. The telephone wires alone remain in the air. Long may they hold their place there; they are perfectly harmless to the general public, and they are enormously less expensive where they are than they could be if placed underground. As for the country, telegraph, telephone and electric light conductors must all be in the air. the cost of placing them underground would be absolutely prohibitory of the great public benefit to be obtained by placing more and more of them in the air.

PERSONALS

Mr. GEORGE INGRAM, Assistant Engineer, Department of City Works, Brooklyn, N. Y., has resigned.

Mr. GEORGE ALEXANDER has been appointed Commissioner of Public Works at Quincy, Mass.

Mr. LEONARD W. JOHNSON, contractor, died recently in New York.

Mr. LYMAN L. GERRY, has been elected City Engineer of Dover, N. H.

Mr. THOMAS WARNOCK, Secretary and Auditor of the New York, Pennsylvania & Ohio R. R., died at Cleveland, O., Feb. 4.

Mr. JOSEPH M. WELLS, architect, junior partner of the firm of McKim, Mead & White, died in New York Feb. 2.

Dr. NORTON, of Tiffin, O., has been appointed by Governor CAMPBELL to the position of Commissioner of Railroads and Telegraphs.

Mr. RUSSELL STURGIS has been elected President of the Architectural League of New York. Mr. FREDERIC CROWNINGSHIELD is Vice-President.

Mr. GEO. W. WEST has been appointed Superintendent of Motive Power of the New York, Ontario & Western Ry., vice Mr. H. TANDY, resigned.

Mr. H. DUNLAP has been appointed Superintendent of Bridges and Buildings for the Eastern division of the Wabash Ry., vice Mr. J. B. MITCHELL, resigned.

Mr. H. WALTER WEBB has been elected Third Vice-President of the New York Central & Hudson River R. R. He will have charge of the operating department.

Mr. E. B. STEWARD, of the shops at Fort Wayne, has been appointed Superintendent of the block signal system on the Pennsylvania R. R., with headquarters at Pittsburg.

Mr. A. H. CATLIN, for several years Superintendent of Air Brakes and Signals on the New York Central Ry., has become General Train Manager on the Pennsylvania, Poughkeepsie & Boston R.R.

Mr. D. D. CURRAN, formerly Louisville & Nashville Yard Master at Birmingham, has been appointed Superintendent of the Savannah & Western division of the Georgia Central R.R, vice Mr. W. G. HARLOW, resigned.

COL. HENRY M. ROBERTS, U. S. Engineers, lately at Philadelphia. Pa., is now the Engineer Commissioner of the District of Columbia, relieving Col. CHARLES W. RAYMOND.

Prof. HENRY DRISLER has been made dean of Columbia College by the trustees, and has had his salary increased and a leave of absence granted for one year from next June.

Mr. J. T. ODELL, formerly Assistant General Manager of the Lake Shore & Michigan Southern Ry., has been appointed General Manager of the Chesapeake & Ohio Ry., vice Mr. HARAHAN resigned.

Mr. RICHARD CARROLL has been appointed General Manager of the Cincinnati, New Orleans, & Texas Pacific Ry. Co. and leased lines, vice Mr. JOHN C. GAULT, resigned. The office of general superintendent has been abolished.

MR. E. SHERMAN GOULD, M. Am. Soc. C. E., has been engaged by Runkle, Smith & Co., 40 Wall street, New York, as Consulting Engineer for the Vento waterworks at Havana, Cuba. Mr. GOULD leaves to-day for Havana.

Mr. J. S. PATTERSON has been appointed Master Mechanic of the Columbus, Hocking Valley & Toledo Ry., vice Mr. I. G. HUTCHINS, Master Mechanic, and Mr. J. M. ROCKAFIELD, Master Car Builder, both resigned. Mr. PATTERSON will be in charge of the motive power and car departments.

Mr. THOMAS EVERSHED, Division Engineer of the New York State canals, died at Rochester, N. Y., last week. He was born in England in 1817, and came to this country in 1835. He constructed the first level of the Erie Canal across the Geneseo River, and made the plans for the locks at Lockport. He was a candidate for the office of State Engineer in 1881.

Mr. JOHN M. TOUCEY, M. Am. Soc. C. E., for several years General Superintendent of the New York Central & Hudson River R. R., has been appointed to the newly created position of General Manager. Mr. THEODORE VOORHEES, M. Am. Soc. C. E., Assistant General Superintendent, has been appointed General Superintendent. The charge of the maintenance and repairs of the track, which heretofore belonged to the operating department, has been placed under the control of the Chief Engineer, Mr. WALTER KATTE, M. Am. Soc. C. E.

PUBLICATIONS RECEIVED.

—*Tenth Annual Report of the State Board of Health of South Carolina for the fiscal year ending Oct.* 31, 1889. J. P. PRATTON, Chairman. Pamphlet, 63 pp.

—*The Water Supply of Pontiac.* By AARON PERRY. Pamphlet, 6 pp. Reprinted from "Report of Proceedings at the Pontiac Sanitary Convention, October, 1889.

—*Statement of the object of the Sanitary Convention.*—*Longevity.* By G. H. T. JOHNSON, M. D.

—*Sewage Disposal.* By W. L SCHENCK, M. D.

The last two pamphlets, of 10 and 8 pp., respectively, contain addresses delivered before the State Sanitary Convention at Emporia, Kan., December 1889.

—*City of Brantford, Province of Ontario.*—*Report on Proposed System of Sewerage and Sewerage Disposal.* By WILLIS CHIPMAN. Toronto, 1890. Pamphlet, 20 pp. and map.

The various systems in vogue are discussed and the separate system recommended.

—*Fifth Biennial Report of the Board of Health of the State of Iowa, for the fiscal period ending June* 30, 1889. Cloth, 276pp.

This report gives considerable space to water and water supply. It will be mentioned further in a later issue.

—*Tenth Annual Report of the Water Commissioners and Superintendent of Water Works of the City of Pawtucket, R. I* Dec. 1, 1889. Pamphlet, 62 pp.

Besides the usual matter contained in the Pawtucket report there is an appendix giving "Abstracts of Test of the No. 1 Pumping Engine," by Prof. J. E. DENTON, of Stevens Institute, Hoboken, N. J. The tests in full are given in ENGINEERING NEWS, beginning in Vol. XXII., p. 663.

—*Railway Associations.* By ALDACE F. WALKER. Reprinted from the *Railway Review* of Jan. 4, 1890. Pamphlet, 5¾ × 8¼ in., 24 pp. Published by the *Railway Review*, Chicago.

Mr. WALKER gives in this paper an account of the present status of traffic associatio s, with the commendable

object of showing that the present popular prejudice against them has no grounds of justice. The unfortunate fact is that this sort of reading matter receives little attention from the general public, or from the legislators who represent them.

—*Water Supplies of Illinois and the Pollution of its Streams.* By JNO. H. RAUCH, M D. With two appendices: I.—"Chemical Investigations of the Water Supplies of Illinois," by Prof J. H. LONG. II.—"The Illinois River Basin in its Relation to Sanitary Engineering, by L. E. COOLEY, C. E. Preliminary Report to the Illinois State Board of Health. 1889. Pamphlet, 81 pp.

These papers are quite exhaustive, and will prove of value to all students who are studying the question of public health.

—*Town of Barrie, Province of Ontario.—Report on Proposed Systems of Water Works and Sewerage.* By WILLIS CHIPMAN, C. E. Toronto, 1890 Pamphlet, 32 pp. and map.

This report is notable on account of its advocacy of city ownership of the proposed water-works, and the reasons therefor. Statistics are given regarding all cities and towns in the Province of Ontario, whose water works are owned and operated by the municipality.

Data regarding the proposed water-works and sewerage will be found in our news columns.

—*Thirty-eighth Annual Report of the Board of Water Commissioners to the Common Council of the city of Detroit for the year* 1889. Pamphlet, 79 pp.

According to this report the average daily per capita consumption increased from 105 galls. in 1878 to 175 gallons in 1888. In March, 1889, a corps of 8 examiners, or inspectors began work to reduce the waste, first by distributing circulars, regarding the condition of the supply and the enormous waste. Following this distribution the consumption was 2,000,000 galls. per day less than for the corresponding days the year previous. The further work of the examiners and some other data on prevention of waste is given in the report; also gallons of water pumped and cost of fuel consumed for each year from 1852 to 1889, inclusive, and much other valuable matter.

Practical Blacksmithing.—A collection of articles contributed at different times by skilled workmen to the columns of the *Blacksmith and Wheelwright*, and covering nearly the whole range of blacksmithing, from the simplest job to some of the most complex forgings. Compiled and edited by M. T. RICHARDSON, Editor of the *Blacksmith & Wheelwright.*

Vol. II. New York, 1889. M. T. RICHARDSON, publisher. 8vo, pp. 260, illustrated. Price $1.

A collection of plainly stated facts regarding a wide range of practice. A book valuable to workmen and mechanical engineers and interesting to all engineers. The first volume related to the early history of blacksmithing, with old and modern tools and shop plans and chimney construction. The present volume treats of bolt and rivet clippers, chisels of all kinds, drills and drilling, fullering and swaging, shears, emery wheels, grindstones' etc. A third volume is to follow, illustrating job work.

—*A Handbook of Engine and Boiler Trials and of the Indicator and Prony Brake.* For Engineers and Technical Schools. By R. H. Thurston, M. A., LL. D., Dr. Eng'g Director of Sibley College, Cornell University, etc., New York, 1890. John Wiley & Sons, publishers; 8vo, 514 pp. Illustrated. Price $5.

While Professor THURSTON modestly starts out in his preface by referring to "this little treatise." the work is really elaborate and full on the subjects treated. It is intended to cover the very latest and best methods of testing engines and boilers, with the apparatus used by expert and experienced engineers, some of which have never before been described. The standard method of testing boilers, as presented to the American Society of Mechanical Engineers, and now generally employed, is given in full. The chapters on Indicator and Prony Brake and other dynamometer tests are especially valuable. The concluding chapters give a number of sample reports, as made by the best engineers, fully setting forth the best methods of presentation of similar reports. An appendix contains a number of valuable tables to be used in connection with the tests required. This treatise is undoubtedly the latest and fullest presentation of modern practice in a field that is ever advancing and improving.

A Text Book on Roofs and Bridges.—Part II. Graphic Statics. By MANSFIELD MERRIMAN, Professor of Civil Engineering, Lehigh University, and HENRY S. JACOBY, Instructor in Civil Engineering, Lehigh University. 1890. New York, John Wiley & Sons, Publishers; 8vo., pp. 124, with diagrams. Price, $2.50.

This publication is intended to cover the second part of the regular Lehigh course of instruction in roofs and bridges; the first having treated of the computation of stresses in roofs and simple bridges. It is an elementary text-book, and the chief features of novelty are in its arrangement and presentation. Mr. JACOBY, however, has introduced abbreviated processes in wind-strain diagrams, in the determination of stresses due to initial tension, and to portions of the analysis of maximum moments and shears under locomotive wheel loads.

In treating of dead and snow loads, the following values are given as useful in preliminary roof design and approximate estimates: The weights here given are in all cases per square foot of roof surface. For covering—Tin, 1 lb.; wooden shingles, 2 to 3 lbs.; iron, 1 to 3 lbs.; slate, 10 lbs.; tiles, 12 to 25 lbs. For sheathing—Boards, 1 in. thick, 3 to 5 lbs. For rafters—1½ to 3 lbs. For purlins—Wood, 1 to 3 lbs.; iron, 2 to 4 lbs. Total roof covering, from 5 to 35 lbs. per square foot of roof surface. The variations in snow load, for latitude, is given as being about 30 lbs. per horizontal square foot in Northern New Eng.and, Canada and Minnesota, about 20 lbs. in the latitude of New York and Chicago, and about 10 lbs. at Baltimore and Cincinnati; south of these points it diminishes rapidly. The plan of this book is simple and easily understood; and as the treatment of all problems is graphical, mathematics can scarcely be said to enter into its composition. Judging from our own correspondence, it is a work for which there is a decided demand outside of technical schools.

TRADE PUBLICATIONS.

—*The Western Engineer.*—Illustrated circular of the Pond Engineering Co., St. Louis, Mo.

—*Centropolis Car & Machine Co.*, Centropolis, Mo.—Illustrated catalogue. The company manufactures freight, mine and dump cars, and has a special department for street, cable and electric cars.

—*The Rivett Lathe and Attachments.*—Illustrated catalogue of the Faneuil Watch Tool Co., Boston, Mass. Size, 6¼ × 4¼ ins.; 47 pp.

This is a catalogue of lathes and lathe attachments for fine and delicate work.

—*The Dow Positive Piston Pump.*—Illustrated descriptive pamphlet; 9½ × 6½ ins., 11 pp. Issued by Francis Bros., Kensington Engine Works, Philadelphia, Pa.

This is a rotary pump, with the paddles revolving in two annular chambers. It is claimed to give the action of a piston or plunger moving in one direction only, no work being done upon the fluid except to move it directly forward in a free, open channel. It may be used for pumping any kind of fluid, and is not affected by muddy or gritty water.

SOCIETY PROCEEDINGS.

Association of Dominion Land Surveyors.—The seventh annual meeting will be held at Ottawa, Ont., Feb 18 and 19.

Reports of committees will be presented, and the following papers read: "Want of Precision in Surveys," John McLatchie; "A Trip to Alaska and Back, via the Mackenzie River," Wm. Ogilvie; "Astronomy," W. T. King; "Hydrographic Surveying," J. J. Boulton; "The Railway Belt in British Columbia," Otto J. Klotz; "Natural History, Canadian Fish," Prof. John Macoun; "Anecdotes of the Noble Red Man," T. D. Chalmers; "Plans and Field Notes of Surveys of Dominion Lands," P. R. Symes; "Surveying for Geological Purposes," W. H. C. Smith; "Practical Chemical Demonstration of the Gelatino Bromide Process." H. N. Topley.

A. O. WHEELER, Secretary, Ottawa.

Engineers' Club of St. Louis.—At the meeting on Feb 5, Mr. Geo. W. Dudley read a paper on "Tests of Water-Works Engines." He explained the meaning and origin of the term "duty," and explained in detail the precautions necessary to be taken in making duty tests, in order that the results might be of value. He submitted reports in detail of two tests of compound condensing duplex direct-acting pumping engines, one of 3,000,000 galls capacity per 24 hours, giving a duty of about 62,500,000 ft.-lbs. per 100 lbs. of coal; the other of 5,000,000 galls. capacity, giving a duty of about 75,000,000.

In the discussion, Mr. Bryan called attention to a simple rule for comparing the efficiency of pumping engines with ordinary steam engines, the evaporation in pounds of water per H. P. per hour being equivalent to the constant 1980, divided by the duty expressed in millions of foot pounds, based upon ten to one evaporation. He called attention to remarkable results that were being guaranteed by makers of compound and triple expansion condensing engines now being built for electric light purposes. Colonel Meier called attention to the necessity of a clearer understanding of this subject of duty, and the desirability of reducing results to a common basis in order that intelligent comparisons might be made.

Prof. Johnson stated that if due allowance were made for engine friction he thought the results would not be so unfavorable to pumping engines as shown by Mr. Bryan. He also called attention to the value of such tests as those reported in Mr. Dudley's paper, and thought they should be made oftener. He explained the construction and use of the Clemens Herschel meter for determining the amount of water pumped. Prof. Gale stated that pumping engines were subject to certain losses, due to friction, for which they were given no credit. This being allowed for, the efficiency would be increased. He also showed that the cost of high-duty engines was an important item, as the increased interest and depreciation accounts might overbalance the saving. He also showed that pumping engines were usually put in of greater capacity than required, so that they were operated under a disadvantage. Mr. Holman called attention to the relative importance of duty as compared with other items of expense in pumping water. In this city the coal bill was less than half of the total cost, the items of labor and repairs being of almost equal importance. He also expressed great doubt as to the reliability of the tests of the old Cornish pumping engines, which were usually held up as standards

The Secretary then read for Mr. J. H. Kinealy a paper entitled "Some Mathematics on Ventilation." The author tested the commonly accepted rules of practice by mathematical deduction, with the result of showing the practice to be well founded. In the discussion Professor Gale stated that the intention of the author was to investigate what difference, if any, must be made in the provision for ventilation between a room occupied only temporarily and the same room occupied continuously. Professor Johnson suggested that mathematical papers of this kind had better be read by title only.

W. H. BRYAN, Secretary.

Northwest Railroad Club.—At the meeting on Saturday, Feb. 8, a paper on "Axles for Heavy Tenders" was read by W. H. Lewis, of the Chicago, Burlington & Northern Railroad. The following is an abstract:

An axle for a heavy tender may be required to carry the following load:

	Lbs.
Water, 3,600 galls	29,480
Coal	16,000
Light weight of tender	28,500
Total	73,980
Deduct weight of wheels and axles	6,400
Weight on axles	67,580

We find the total weight carried is somewhat less than that of cars of 60,000 lbs. capacity, and we will therefore assume that the general dimensions adopted by the M. C. B. Association for cars of that capacity are ample.

The C., B. & N. Co. has 15 locomotives with tenders of the above weight and capacity fitted with M. C. B. Standard axles with 3¾ × 7 in. journals. To explain the desirability of increasing the length of the journal from 7 to 8 ins.; it has been demonstrated by practice that the surface in contact should not exceed a pressure of 300 lbs. per sq. in. of bearing. For the weight of heavy tender given above, with a journal 3¾ ins., the weight per square inch is 301 lbs., while with a 4 × 8-in. bearing, with an area of bearing surface of 32 sq. ins., the pressure is 263.75 lbs. per sq. in.

In view of the fact that the M. C. B. Association has adopted an axle for 60,000 lbs. capacity cars, I would recommend that we conform as nearly as possible to that design, with the exception of the diameter of journal, dust-guard and collar, which I would recommend to be 4 in., 4⅞ in. and 4¾ in. respectively.

Experience has demonstrated that the strength of a 4-in. diameter journal is ample, and, according to "Trautwine," is capable of sustaining a load of 201 tons with a fulcrum of 6 ins., or 199 tons at a fulcrum of 12 ins.; or, in other words, the factor of safety is 25, which is very largely in excess of any requirements in practice.

In this connection I wish to call your attention to the light ratio of increased pressure between a fulcrum of 6 and 12ins. Many master mechanics have opposed the increase of the length of journals from 7 to 8 ins. on account of what they termed the increased leverage of the journal. Yet we see from the above figures that the decrease in the breaking power was only four tons or 4 per cent. of the total, which, reduced to the actual increase of bearings from 7 to 8 ins., represents a small increase in this direction.

I favor an axle with collars, for the reason that with the style of trucks commonly used under tenders the collars serve to tie the bars of the truck together, and prevent them from spreading. This is especially important in case of derailments.

I recommend that the end collar and dust guard be each 4¾ ins. diameter, so that they will go into the present M. C. B. box. Other dimensions of the axles should be as follows: Journal, 4 ins. diameter, 8 ins. long; dust guard-seat, 4⅞ ins. diameter, 2 ins, long.; wheel seat, 5⅝ ins. diameter, 7¼ ins. long. The end collar should be ⅝ in. long. The axle should be 7 ft. ¼ in. over all, and 4⅝ ins. diameter at the center.

As to the form of axle: I do not like the form in which the axle tapers gradually to the centre, thus concentrating all the vibration at that point. I prefer the axle of the same diameter, for 12 ins. each way from that center, and then increasing gradually to the wheel seat.

The paper was discussed by Messrs. Greatsinger, Potter, McIntosh, Warren, and others.

Some tenders were described which were running on journals 3¾ × 7 and 3½ × 7 ins., and had given satisfaction. Mr. Potter described trials of the old style M. C. B. axle, with journals 3¾ × 7 ins. under 3,600 gall. tanks. Several of these axles broke when the axle became worn to 3⅝ ins. diameter. In most journals he had seen broken the failure was due to the lead lining cutting away the fillet on the inside end of the journal, and even cutting in so that it weakened the journal even more than a square shoulder would have done.

ENGINEERING NEWS

AND

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Published Weekly at Tribune Building, New York.

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D. McN. STAUFFER A. M. WELLINGTON

EDITORS.

CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER

ASSOCIATE EDITORS.

GEO. H. FROST . . . . . BUSINESS MANAGER

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COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia, Pa.—Next meeting, Feb. 15. Secy., Howard Murphy, 1122 Girard St.

Western Railway Club, Chicago, Ill.—Next meeting, Feb. 18. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, Feb. 18. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, Feb. 18. Secy., S. E. Tinkham, City Hall.

Engineers' Club of St. Louis, Mo.—Next meeting, Feb. 18. Secy., W. H. Bryan, 46 Laclede Building.

American Institute of Mining Engineers.—Annual meeting at Washington, D. C., Feb. 18 to 22. Secy., Prof. R. W. Raymond, 6 Burling Slip, New York City.

American Society of Civil Engineers, New York.—Next meeting, Feb. 19. Secy., John Bogart, 127 E. 23d St.

New York Railway Club.—Next meeting, Feb. 20. Rooms at 113 Liberty St.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, Feb. 20. Secy., Clement March.

Engineers' Club of Kansas City, Mo.—Next meeting, March 3. "Photography Applied to Surveying." G. W. Pearsons, Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, March 3. Secy., Geo. L. Wilson, City Hall.

Western Society of Engineers, Chicago, Ill.—Next meeting, March 5. Secy., J. W. Weston, 280 La Salle St.

Civil Engineers' Club, Cleveland, O.—Next meeting, March 11. Secy., C. O. Palmer, 23 Cedar Ave.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, March 12. Secy., J. C. Herring, Wichita.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, March 13. Secy., Olin H. Landreth, Vanderbilt University.

IN ANSWER to several letters before us, we would again say that we never send receipts for money sent for subscriptions unless there is some special purpose in so doing. The address tag on the paper showing expiration of subscription is intended to cover this point, and to save us much trouble and postage.

A POINT has been raised by Col. T. P. ROBERTS, C. E., of Pittsburg, Pa., regarding the advisability of building the geographical network of county roads in New York State suggested in Gov. HILL's message. Col. ROBERTS thinks that roads should first be built on the lines upon which people want to travel, to trade centres and railway stations, and not arbitrarily across counties to connect with other county roads. This point would be well taken if any such programme were contemplated; but we do not for a moment suppose that Gov. HILL's roads are really to be laid down regardless of local needs. As a matter of public policy all roads should ultimately be good roads, and some general and comprehensive system should be followed from the start. But by beginning on the roads most in use, and leading to centres of trade and travel, and extending them year by year, the originally isolated territory commanded by these local roads will gradually be joined to surrounding territory, and the conditions demanded both by Gov. HILL and Col. ROBERTS will be satisfied.

The plan outlined in the Governor's message, of building two intersecting highways across each county and connecting them with similar roads in the adjoining counties, is practically a somewhat crude outline of the contemplated system. The fact that the County Commissioners of each county would have very considerable power given them in fixing the location of such main highways certainly does not presuppose any intended disregard of local demands. The one great point aimed at in the plan proposed for New York State is a carefully considered general system of highways, in part located by and with the construction directly under the supervision of trained engineers. This is, after all, the chief thing to be considered. State and local treasuries combined could not stand the strain of at once building any such network of roads; and the local authorities, who would have to pay in considerable part for the improvement, can be depended upon to see to it that the first work to be done will be on those lines where the greatest immediate good can be derived. The State network of main highways would doubtless come in time; but it would follow the local roads radiating from local centres of importance, and it would be the duty of engineers and local authorities combined to see that these separate links ultimately united into one perfect chain, or series of chains, covering the State.

Mr. LOOMIS, the new Street Cleaning Commissioner of New York, has announced that efficient work cannot be done, for the money available, under the existing system of cleaning streets by day's work, and he will within a few weeks reintroduce the contract system. But the specifications of these contracts will be more stringent than any hitherto known for this service, and Mr. LOOMIS is confident that he can enforce them and make the change advantageous to the city in the character of the work performed.

This scheme will probably be antagonized by the purely political material in our city government, and vigorous attempts will doubtless be made to capture the contractor and his force for political purposes. And if the politicians succeed in this latter attempt, the change will practically be one of form, rather than of effectiveness. But judging from the manner of his appointment and the spirit of real reform shown by the present Commissioner, Mr. LOOMIS is in a better position to fairly test the merits of an honestly and vigorously administered system of contract work than were his predecessors, and the merits of the system itself are sufficiently pronounced to make the attempt well worth trying. Under the present plan the work is performed by a class of labor that firmly believes that the city owes it a living for other service than handling a broom or hoe, and the street surface suffers in proportion from careless and lazy work. The public may complain and the heads of departments may really desire better work, but as long as the laborer feels secure in city employment for political service neither complaints, growls, nor earnest desire are of the slightest avail.

Properly administered and stringently enforced, a contract means the immediate discharge of all labor that does not turn money into the contractor's pocket by the vigorous use of muscle; the man must work or the master cannot meet his engagements and liabilities, and as long as the contractor is made to feel that his contract price will be his sole return for service, and that he will be strictly held to the specifications of that contract, the public can depend upon him to manage the labor and hold the Commissioner responsible for the class of work performed. Under this condition of affairs responsibility can be fixed, and as every citizen would be an inspector, the citizen knows who to howl at if things go wrong. Under the day's work system the men really responsible for the present undoubtedly bad state of affairs are secure from public blame and criticism; the laboror cannot be held and does not care, and the head of the department is handicapped by all manner of obligations, so that he cannot control. If Mr. LOOMIS can change all this by putting and keeping a contract system on a true business basis, he will give New York the cleanest highways it has had for many years, and much enhance a reputation for firmness of purpose and executive ability. But it will tax his ability to the utmost, and we do not envy him the task.

In this reform Mr. LOOMIS must have the earnest support of almost every other branch of the city government; otherwise even his best efforts will fall short of what should be the standard. He now has the nominal support, at least, of the Police Department in enforcing ordinances that effect the deposit of rubbish and the storing of vehicles, etc., on our streets. But what he must also have is concerted action in street-paving, pipe and conduit-laying, repairs and anything that means breaking the street surface. Better and smoother pavements, the abolition of the present abominable centre-bearing rail and a better road between rails, and the immediate repair of all pavement defects, are items that do not come under his department, but each and every one has an important bearing upon his work, and they are defects that cannot be too soon remedied if New York really wants clean streets.

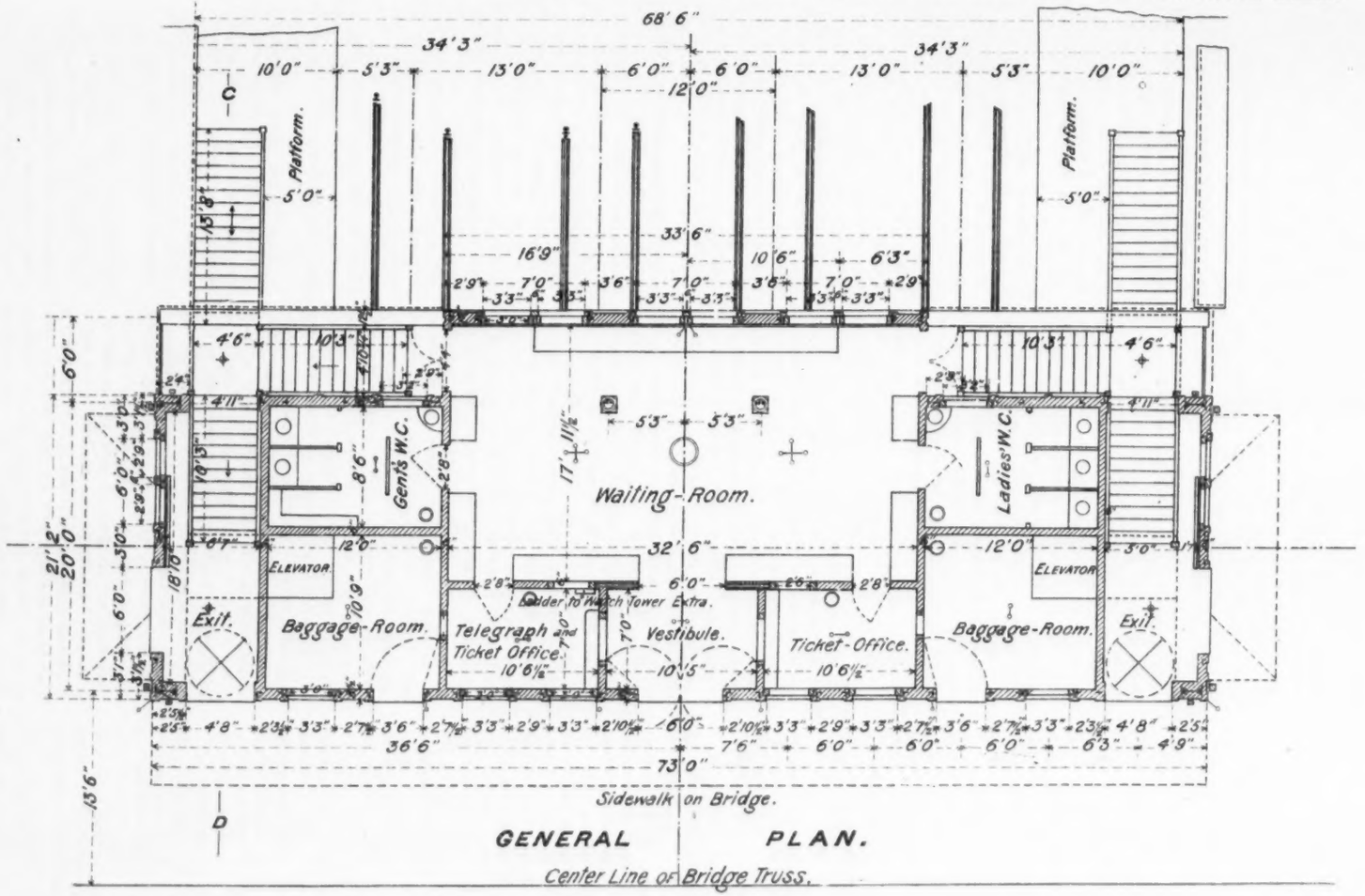
The Service Record of M. C. B. Standard Freight Couplers.

We recently had the pleasure of laying before our readers (Dec. 21, 1889) a map making a very striking exhibit, as it seemed to us, of the rapid rate at which automatic freight train brakes and automatic freight couplers of the new M. C. B. standard type were being introduced. The fact that 78,000 M. C. B. couplers were put on last year, against only 30,000 the year before, and only 12,000 in all time before then, tells its own story as to the rapidity with which a great movement is advancing; but to realize the extent to which it has already gone, it is necessary to see a map of the lines which have already taken part in it to such an extent as to indicate a permanent policy, and not a mere experiment.

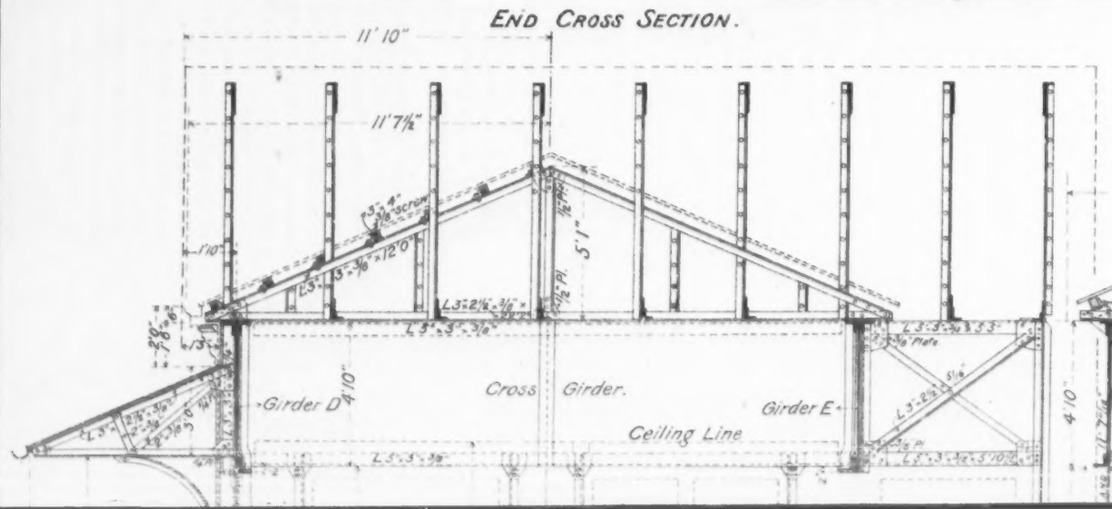
Such general movements do not come by chance. Neither do they come from the mere fact that the type has been "standardized." That fact alone goes but little way to introduce a new mechanical detail into use, as the history of a number of the M. C. B. standards would fully show. Solid merit, as well as M. C. B. indorsement, must be behind it, especially when it involves a large expenditure, as the new standard coupler undoubtedly does. It was, therefore, we do not doubt, with a reassured surprise that many of our readers saw how far this

STANDARD STATION, HARLEM DEPRESSION, NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.

WALTER KATTE, CHIEF ENGINEER.



GENERAL PLAN.



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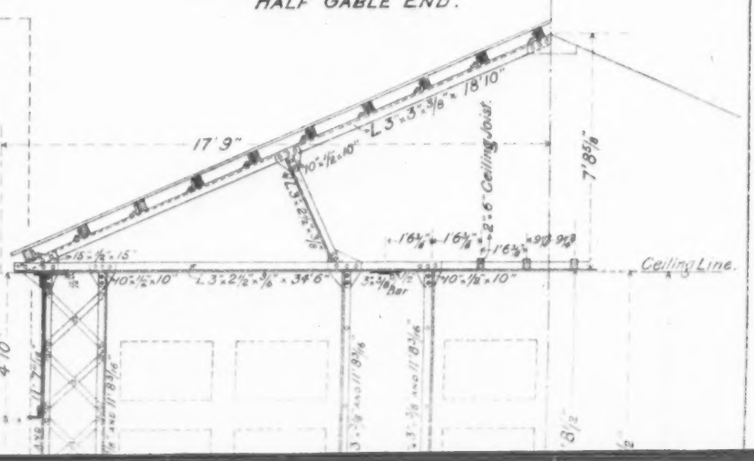
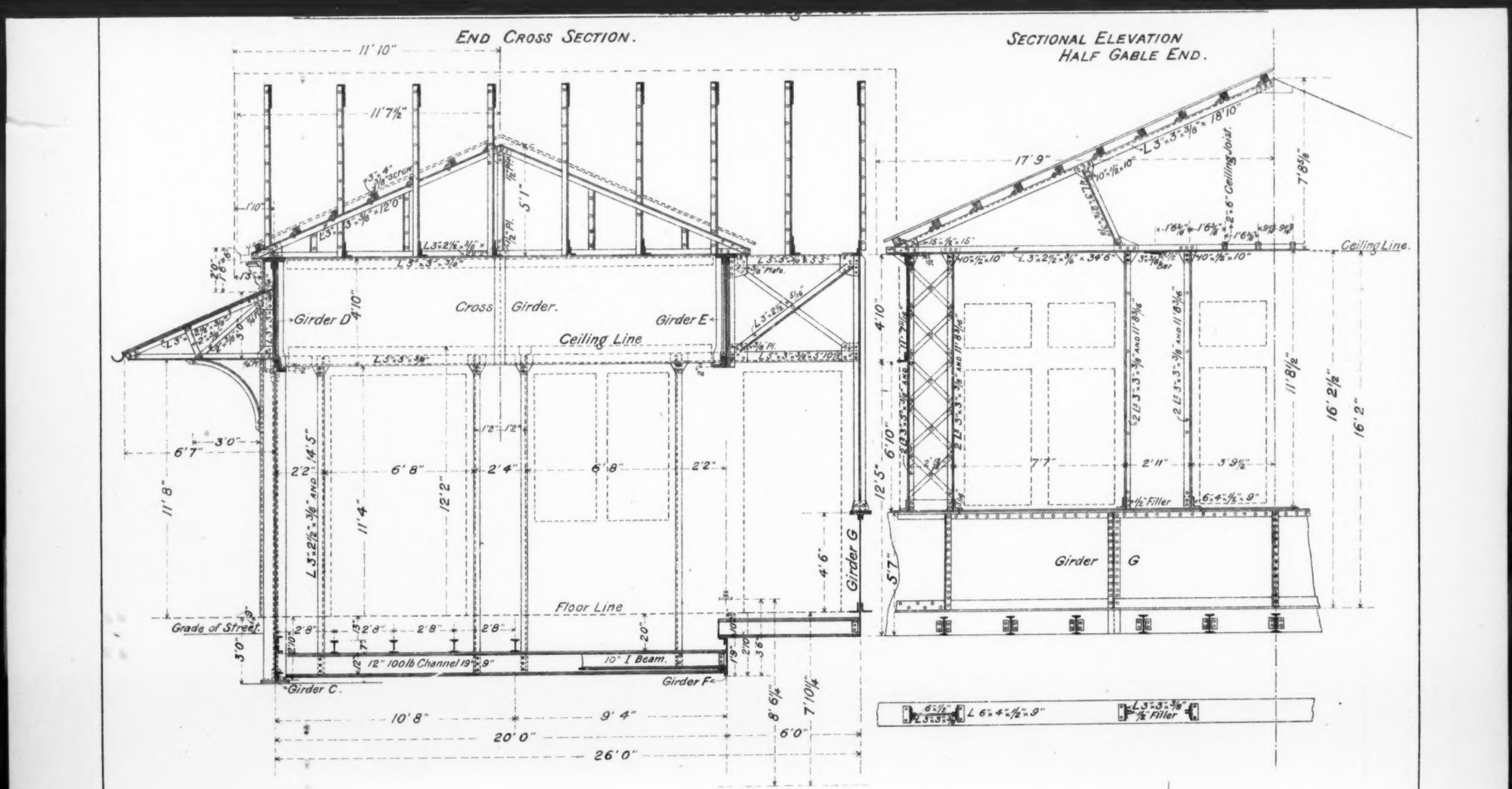
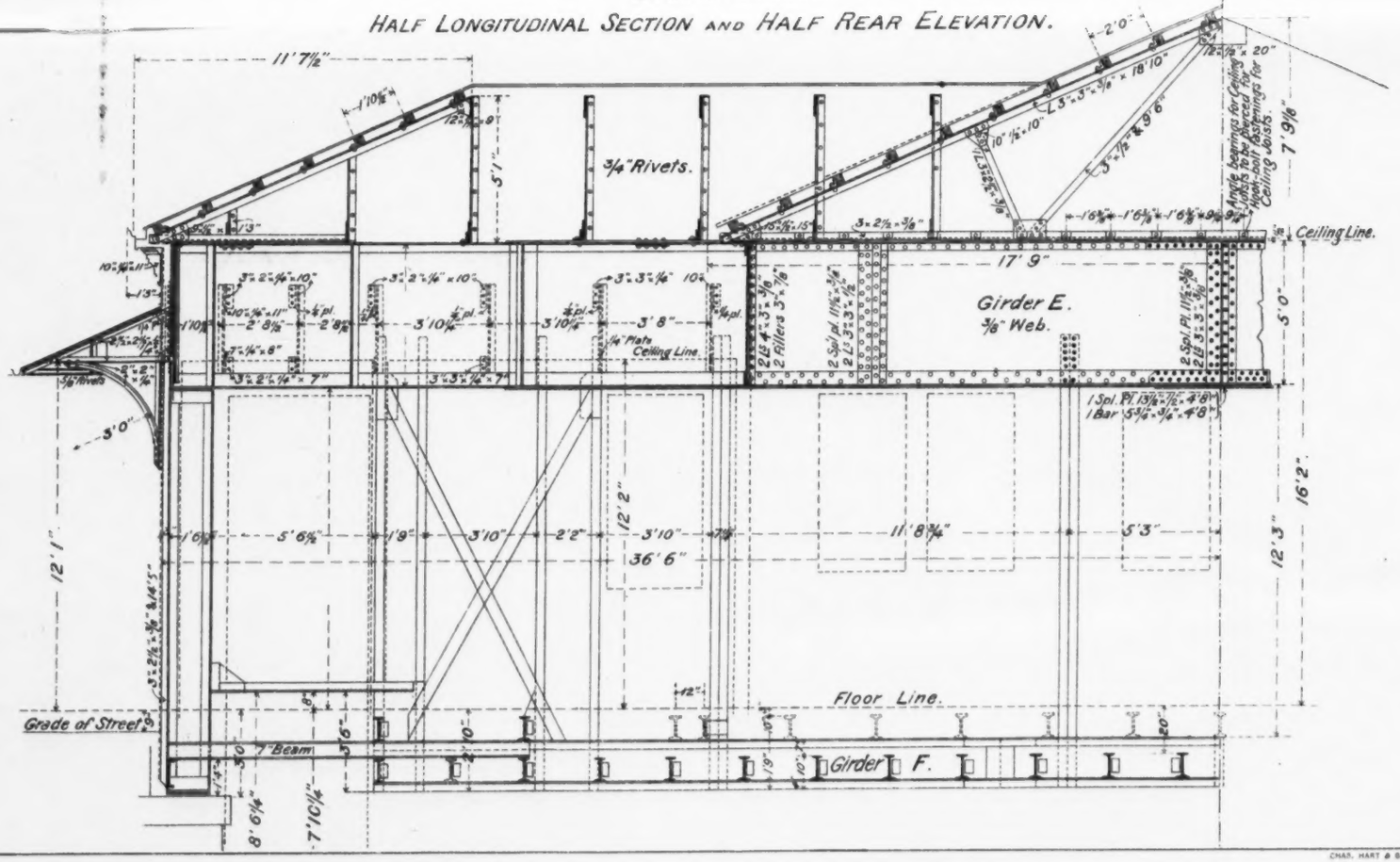


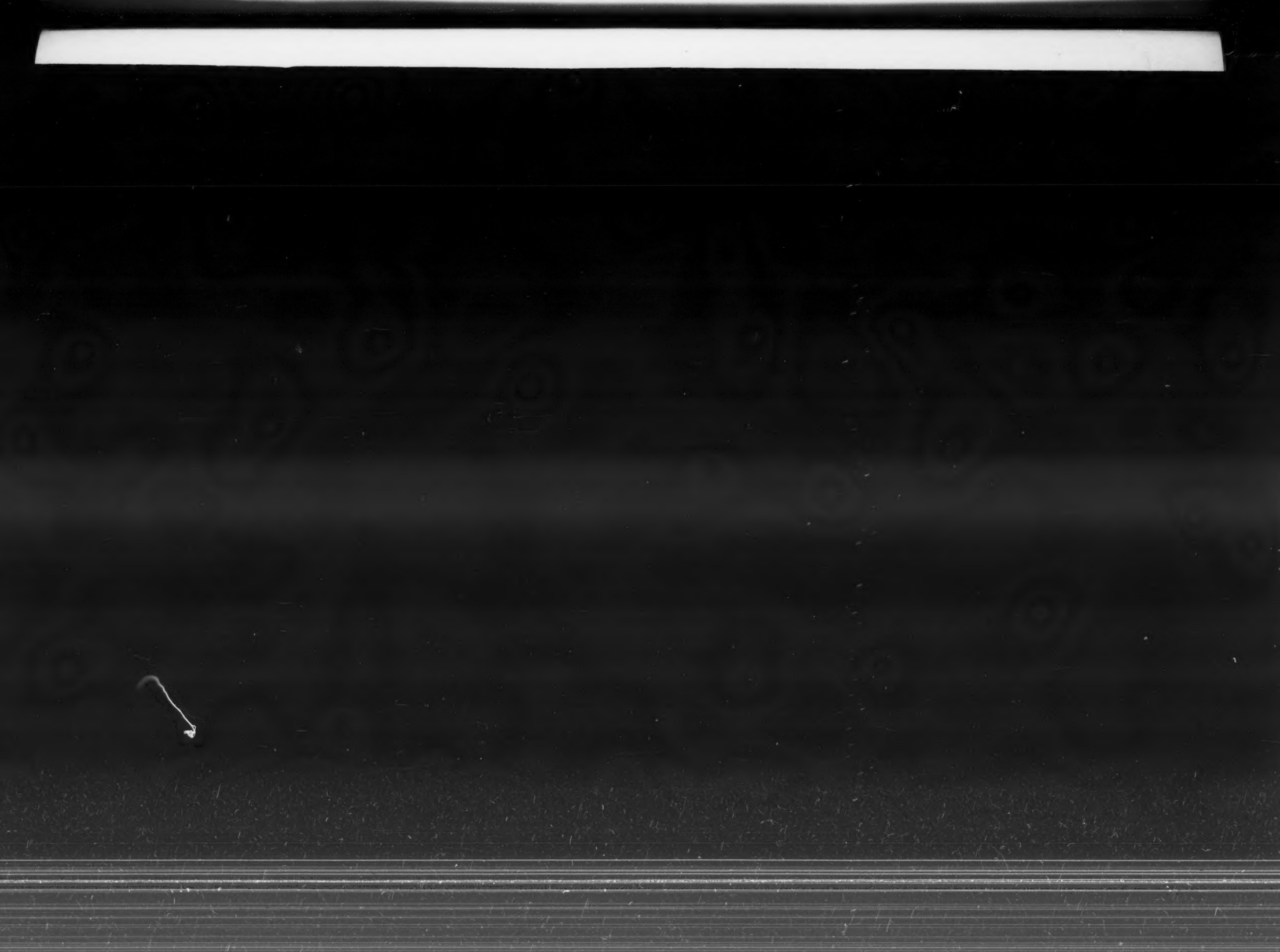
SECTIONAL ELEVATION HALF GABLE END.


END CROSS SECTION.
SECTIONAL ELEVATION
HALF GABLE END.
HALF LONGITUDINAL SECTION AND HALF REAR ELEVATION.
Girder D
Cross Girder.
Girder E
Ceiling Line
Floor Line
Grade of Street
Girder C.
Girder F.
Girder G
12" 100 lb Channel
10" I Beam.
Ceiling Line.
Girder G
11' 10"
11' 7½"
17' 9"
26' 0"
20' 0"
10' 8"
9' 4"
6' 0"

HALF LONGITUDINAL SECTION AND HALF REAR ELEVATION.



CHAS. HART & BORB, LITH., 36 VESEY ST., N.Y.



movement had already advanced, for it was in itself a pretty strong evidence that experience with the new standard was favorable.

As an indirect result of this showing, we are now able to present to our readers direct proof of a high character that experience with the new M. C. B. coupler, at least in its best forms, is so far more than satisfactory, in the full records presented elsewhere of *all* the breakages which have so far occurred and been reported on any road in the coupler which, without prejudice to the other excellent devices which are before the public, we may fairly call the leading make at present, as it is the original and oldest make. The exact facts as to the behavior in service of 45,677 of these couplers, or more than existed of any make a year ago, yet which have averaged nearly a year of service, are recorded in full elsewhere in this issue; and we risk nothing in saying that a more extensive, a more convincing, a more detailed, and a more satisfactory exhibit was never made for any one mechanical device whatever, of an at all analogous nature.

Not only is this record now for the first time accessible, but two or three weeks ago it did not exist, but only the raw material for it in the form of detail records of 2,444 individual fractures. These were consolidated by the manufacturers of the coupler, the McConway & Torley Co., into the statements shown in Tables 1, 2 and 3 on another page (except as to the roads which were similarly abstracted by us from the original records), and these in turn have been reduced by us, according to our best judgment, unfettered by any conditions from the manufacturers, into the form which seemed to us best calculated to make clear the real facts of the case, as they appear on another page. We give there also all the original data, as the importance of the record seemed to demand, so that the reader is not obliged, unless he chooses, to take anything on faith.

The main indications as to the question which is of most immediate interest to the railroad world, the probable durability and maintenance cost of M. C. B. couplers, may be thus summarized.

The average fractures of the coupler proper (excluding the knuckles), in the first 8 or 10 months of service, are now running on all roads having considerable numbers in service *at the rate of* 2½ to 3 couplers per annum per 100 couplers in service, of which about two-thirds are classed as failing from some original defect and are replaced by the manufacturers free of charge, and the remaining one-third are classed as failing from unfair usage or without fault of the manufacturers. The coupler breakages which are a charge on maintenance funds, as an average of 45,617 couplers from which there are but small variations even in lots of a few hundred, are at the rate of 0.8 to 1.0 couplers per 100 in service one year.

The cost of the coupler proper is $8.50 each, or $17 per car, the cost of the knuckles being $4 each, or $8 per car, making $25 per car in all. At this rate, therefore, the average company is now called upon to expend from $6.80 to $8.50 per 100 couplers yearly for coupler renewals, or 13.6 cts. to 17 cts. per car. What they are now paying for old-style drawbars we will consider later.

Better than this may conceivably be attained hereafter by the same or other manufacturers, or may be now attained or attainable by some other maker. Some large companies are now obtaining a decidedly better record with the Janney couplers; but if any railway is now having a worse experience than this on any considerable scale, it is clearly its own fault in not making a wise selection of coupler, or in not treating them properly. If any proof is capable of establishing such a fact beyond cavil, this would seem to be established.

Considering to what extent this record, for an average service of somewhat less than a year only, is likely to be a fair criterion of the future, it is evident that the portion of the fractures which arise from original defects is likely to be abnormally great in the first few months of service, and to continually grow less thereafter. The benefit of this will inure to the manufacturers and not to the companies, since the latter are now held harmless against them.

Of the couplers which fail from no specific defect, the same is likely to be true to some extent. The weaker ones will go first, as with human beings, and the "death rate" will for a time decrease, even among the sound couplers, to increase only as they approach old age. Therefore, in view of the present showing, it is difficult to see why the renewals chargeable to the companies should for many years rise above the rate of one per cent. per annum; yet that it must eventually rise above it is certain, unless the average life of sound couplers is to be a hundred years, which is hardly probable. Yet that the life may be long is highly probable. Many locomotive axles last ten years, and the strains of an axle are highly destructive. Driving wheel centers will last forty years. As a whole we do not see why a coupler which does not break from blows (which will hereafter be constantly less destructive) may not in cases last almost indefinitely. But it would be irrational to assume a longer life than thirty years, as an outside limit, apart from failures for cause, which means more than *three times* the present actual rate of breakage chargeable to the companies; and it would be irrational to assume so much as that, except that it exceeds the present rate of all breakages, even in the early months of service in this transition period.

The knuckles break much more freely than the couplers, and also at a much more irregular rate. Coupler breakages are nearly at the same rate everywhere, but knuckle breakages are more than twice as frequent on the roads of fewest M. C. B. couplers and of shortest average service, averaging 7½ per cent. per year on such roads, against less than 3 per cent. per year on the older roads. In some plainly exceptional and temporary instances the knuckle fractures rise to 10 or 12 per cent. a year. The returns bear positive evidence, detailed elsewhere, that this is due to rough usage.

As a whole, there seems to be the clearest evidence in the records that the normal rate of knuckle breakage under present conditions, with a fair proportion of M. C. B. couplers in service, is not over 3 per cent. per annum, or $12 per 50 cars, or 24 cts. per car per year, of which half is borne by the makers, under their permanent contract to replace two broken knuckles, from whatever cause, by one sound one. These fractures are almost exclusively in the knuckle lugs, provided to permit of coupling with the link and pin. When the necessity for this provision has disappeared, and the knuckle end can be made solid, it seems quite certain from the records that this percentage will be heavily decreased. This is shown affirmatively, we may add, by experience with couplers for a thousand cars sent to China with a solid end knuckle, among which there have been so far no breakages.

Now, the day when the link and pin facilities can be dispensed with may be nearer at hand than is realized. Already nearly 10 per cent. of the freight stock of the country is either provided with M. C. B. couplers, or has them ordered, and this has mostly been done within the past year, when no one realized how rapidly the country as a whole was acting, and when no positive evidence was available that the new type was an already perfected device, much cheaper as well as better than the link style of coupler, and hardly capable of much further improvement. Such evidence—the strongest by far that we ever knew produced for any new device—we furnish in this issue.

It cannot but accelerate the progress of the movement. The frightful annual slaughter from link coupling will have an increased effect upon the sympathies of railway officers, and cause increased pressure from the public, when link coupling is seen to be an expensive as well as inhuman method. The vast operating economies which we discussed at length in our issue of Dec. 21, 1889, but can now only allude to, as likely to result from the joint use of automatic brakes and couplers on complete freight trains, by enabling longer trains to be more quickly handled, will begin to be better appreciated. In the meantime, the entire freight stock of the country is practically renewed every ten or twelve years. A car six years old is by the interchange rules worth only 64 per cent. of its cost new. All these causes seem certain to hasten the day when 60 or 70 per cent. of the freight cars of the country will be equipped with M. C. B. couplers, and about then the inconvenience and danger of mixing in link cars in freight will be quite certain to result in a refusal to them of interchange facilities; the great roads cannot then afford to be bothered by them. When that day comes, the doom of the "bull nose" is sealed, and knuckle ends can be made solid; and it will be in no way surprising should this day come before the end of 1895.

The rate of knuckle breakages among "young" knuckles will then quite certainly fall to very small figures; but knuckles, unlike the coupler proper, are subjected to considerable wear, and therefore the permanent rate cannot well ever fall to less than the present rate of 3 per cent. It ought to average considerably more to wear out knuckles fast enough to suit an apparently reasonable average life.

Summarizing the yearly cost which is "in sight" for coupler maintenance for the first few years ahead, we have:

	Per car.
For couplers proper, ex those replaced by makers, say 1 per cent. per year, or	17 cts.
For knuckle breakages, at 3 per cent. per year, half of 24 cts. per car, or	12 cts.
Total visible cost per car for coupler and knuckle maintainance	29 cts.

This is very, very low. We do not say it will be realized. We do not say that we believe it will be realized. It is too good to be true. It is not a third of the present cost of links and pins alone. But we do say that it is all that the records submitted to us, fairly and impartially analyzed, afford warrant for estimating; and we will say further, that not only have we entire confidence in the good faith of those who furnished us with the records, but we credit them with the possession of some lingering sparks of intelligence, and therefore cannot assume that they would permit detail records of individual roads to be spread before the public which would not stand the strictest investigation, and any considerable errors in which would be certain to be at once exposed. As to two of the eleven roads given, moreover, the records have come to us direct from the companies, without any intermediary, and these records correspond with singular closeness, both in gross and in detail, with the others, as may be seen at a glance by turning to the diagrams on another page.

We therefore entertain a conviction approaching to certainty that we are laying before our readers herewith an understatement rather than an overstatement of the actual facts of *present* experience. If any are having a worse experience, as we said before, they have themselves to thank for it. *A priori* we should expect such a record to grow better rather than worse with each succeeding year, for many reasons stated and unstated; but as this leads to entirely inadmissible conclusions, we are forced to the conclusion that the newness of the individual couplers does more good than the newness of the whole system and other adverse conditions does harm, and that the yearly percentage of broken couplers will hereafter increase above what has been actually attained in the first year's experience with 46,000 couplers, under conditions which are certainly in many important respects peculiarly adverse, and sure to steadily improve.

However this may be, one thing at least seems

to be proved by the facts, looked at from any point of view, that there is no great room for further improvement in the coupler. Instead of having to make allowance for the usual troubles of infancy to find an encouraging showing, we have to assume a steady, unlocalized deterioration from wear and tear of service to get at what seems a reasonable permanent ratio. Such deterioration being from causes external to the coupler, and not internal to it, is in its nature incurable by any change in the coupler itself, or, at least, by any change not amounting to a change of type, and to such a change of type, moreover, if we can conceive of it, as would reduce the effect of the only causes tending to produce sensible deterioration, the buffing and tensile strains.

That the coupler cannot be sensibly improved by changing its proportions, *i. e.*, by taking metal from one part to add it to another, seems to be conclusively proved by the singularly even distribution of the coupler fractures among the different parts of the coupler. The diagrams and tables on another page should be studied in this respect. The showing seems to us indeed remarkable. It was not always thus. As is pretty generally known, it has taken a long series of costly, and at times discouraging, experiments to bring this about. But when "each part is as strong as the rest," and all are creditably strong, there does not seem to be great room left for improvement in the details of design. The deacon who built the famous "one-hoss shay" expounded well the theory of this matter, according to his veracious historian:

> "Fur," said the Deacon, "it's mighty plain
> That the weakes' place mus' stan' the strain.
> 'n' the way t' fix it, uz I maintain,
> Is only jest
> T' make that pla'e uz strong uz the rest."

The doubter who is still waiting for "further improvements," therefore, must be waiting either for the coupler to be made of better *and also cheaper* material, or to have it all still further strengthened throughout. But the chance that any better and also cheaper material than malleable iron for such a use will be found in this century is too remote for consideration: certainly none such exists.

As for a still further general strengthening, granting that it is rational to now discuss it under existing conditions, let us see where it would land us: Let us assume that adding 10 per cent. more metal, or some 21 lbs., would save 20 per cent. of the breakages,—an extravagant assumption; it would be more likely to save none at all. Let us also assume that the added metal would cost only 3 cents per lb. (63 cents per coupler), although it would cost more. The interest charge alone on this at 6 per cent. would be 3.8 cents per year, or 7.6 cents per car. But 20 per cent. of the breakages chargeable to the companies which are now "in sight" amounts to only one fifth of 17 cents per year or 3.4 cents per year.

At any rate, it is perfectly clear, from the facts now given, that the record gives an absolute negative to all charges that there is anything justly alarming in present experience anywhere with the M. C. B. type. No single company is having any alarming experience with the oldest and at present leading type of the M. C. B. coupler, but quite the contrary. There may be others which are making as good or even a better record; if so, we shall hope to present the facts later, as we need not say we shall be glad to do. If there be any makes which are making a worse record, so as to give just cause for alarm in themselves, no sensible man would be alarmed at them, nor attach great weight to them, as affecting the merits of the type, until he had ascertained that not only were there others as bad, but that there were none on any large scale really good. We have no definite information that any single make of the M. B. C. type is now making what may be fairly called a bad record when properly analyzed; but if there be, it is only another illustration of the general law that there is likely to be dozens of attempts to fill any new demand of this kind, of which but a few will succeed. Such failures do not affect the merit nor the promise of the successes.

We have room for but a few words more on the question of the comparative maintenance cost of the old and new style of couplers. The quotation of some recent authoritative figures from the Chicago, Burlington & Quincy road must suffice for this, although we could supplement this statement with a dozen or so of others to the same general effect which we have collected. In a letter transmitting the records which make the comparative showing given elsewhere—almost exactly identical with the general average of fifty times as many cars—the fear is expressed that the record is too good to be a fair average, and it is further added:

> I think you will agree with me that if the record of a few years ago was "an appalling one" of badness, the record of to-day is a startling one of goodness. This will be more apparent when we consider the following figures, which show the cost and number of links, pins and Potter drawbars used on the C., B. & Q. alone during the year 1888. [This does not include proprietary lines.]
>
> Total number of links, 60,990; cost $13,305.60
> " " pins, 100,797 " 12,846.40
> " " Potter drawbars, 6,826; cost ... 29,990.80
> Total cost $56,142.80

The C., B. & Q had at the end of 1888, according to Poor, 26,130 cars. Therefore the cost of these items per car and per 100 couplers (or 50 cars) was as follows:

	No. per car.	Cost per car.	Per 100 couplers.
Links	2.33	50.9 cts.	$25.45
Pins	3.82	49.1 "	24.55
Drawbars	0.26	114.9 "	57.45
Total		214.9 cts.	$107.45
Against present visible cost of M. C. B. couplers		29.0 cts.	$14.50
Ratio, M. C. B. to link and pin		1 to 7.4	1 to 7.4

Another of the large companies whose Janney record is given on another page has determined by a careful record that its average cost for link and pins is a few cents over $1 per car, although we are not able yet to give the exact figures. It is a well-determined fact that this is a moderate estimate for this purpose, some roads having reported much more.

If we may credit M. C. B. couplers with a similar maintenance allowance, leaving its other advantages alone as the inducement for the change, we may renew 4 per cent. of the couplers annually at the company's expense, in addition to all those renewed free as defective, before the margin is exhausted. Keeping this in mind, and referring to the diagrams on another page, the reader can see for himself how much present prospect there is that the margin will be exhausted.

CORRESPONDENCE.

Aluminum Transits.

OGDEN, Utah, Feb. 5, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I see in a late issue that you favor the use of aluminum for engineering instruments.

I once tried to use a transit made of that metal some years ago in Leadville; but after an hour's fruitless and exasperating attempt to set a point or read the stadia rod, I had to go in and get another. The instrument was so light that the rodman seemed to dance a jig, and the wind was not stronger than ordinary. What would it have been in a gale?

I would not buy an instrument much lighter than what is commonly called "a light transit;" and for the windy plains, west of Kansas, a No. 1 Buff & Berger, with a heavy plummet, has about the right weight.

Yours truly, FRED. MATHYAS.

Concerning Horizontal Stadia Reading.

ROCKLAND, Me., Feb. 11, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I notice in your last a communication from J. F. Ford, C. E., in relation to an improvement in stadia practice. The idea in its principles is not new to me, though I have never seen it used. Of course a great saving of time and labor could be made by such an arrangement—when it would work.

There is, however one very serious obstacle to its general adoption (which, however, may have no bearing on its use by your correspondent), that is, in this country it frequently becomes necessary to take sights in the woods, where the line is perhaps cleared just wide enough to permit a sight to be taken on a ranging pole. Now I think those used to working under such circumstances will agree with me that however desirable the vertical hair and horizontal rod may be under other circumstances, they certainly cannot be used by us.

I make more use of stadia measurements than most engineers do, and hence take more interest in the matter.

Yours truly. O. H. TRIPP.

American vs. English Locomotives.

CORVALLIS, Ore., Jan. 29, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Personally I feel indebted to you for your article in the issue of Jan. 18, on the question of priority of design in American and English locomotives.

It has settled my convictions on a muchly vexed question, and those, no doubt, of a multitude of other subscribers to your journal who, like myself, were anxious to get at the truth, more as an historical fact than as a question of mere national prestige.

As a naturalized American with a strong love for Anglo-Saxondom, whether here or there, will you extend to me the courtesies of your journal to say a word on this burning question of the English vs. American locomotives.

It was recently my good fortune to secure a ride on the locomotive of the Pennsylvania Limited, and a week later on the foot-plate of a crack English express. This comparison, and the comparison of various types in both countries, convinced me that each type was admirably adapted to the work it had to do, and that each was the inevitable outcome of the conditions of the country that produced it.

In America, 6° to 10° curves have called for the truck, with its vertical and lateral flexibility. In England, the easy curvature of earlier locations admitted of the simpler form of a single pair of leaders; but when later locations, as through the crooked valleys of Derbyshire on the Midland Ry. were made, we find that company introducing the truck for that especial piece of line, the same thing occurring on several other similar lines in due course.

In America, the necessarily rough track and light iron of preliminary construction called for equalizing levers; but in England, which had in those days the advantage of America in the command of capital, track was laid with a solidity and beautiful truth that rendered equalizers a superfluity.

In America the scarcity of skilled mechanics in early days, and the consequent necessity for making the parts easy to get at for repairs, no doubt in part led to the adoption of outside cylinders; and the demand for cheap track was coupled with a demand for cheap locomotives, and hence, more especially, the outside cylinders, the bar frame and the cast wheels.

In a word, the American locomotive was—and is yet—built on principles of the most rigid utility; it is built under the spur of the keenest competition, and to get a machine that shall combine cheapness with durability, is the first aim of the builder

The English locomotive is built on principles of utility, but a utility which considers that article the most useful which is made of the very best material, disposed to the very best advantage, even though such selection, disposition and finish entail a heavy first cost.

Just here is found the explanation of the 2:3 ratio of cost of American and English locomotives.

The riveted plate frame, more costly than the bar frame to put up, but a more scientific distribution of the material, considering the vertical stresses to which it is subject; the copper fire-box and brass tubes, a more costly selection again, but in view of their higher conductivity a more scientific one; the inside cylinders, necessitating the double cranked axle, again a more costly, and again a more scientific disposition of parts, reducing the moments of these parts about the center line of the locomotive to a minimum, and substituting for the enormous sway of the outside-connected, the wonderful lateral quiet of the inside-connected locomotive; and lastly, the all-around broader bearing surfaces in the English locomotives—these differences are the result of an effort to produce a first-class job at a second-class price, and a first-class job at a first-class price.

The question, then, in some degree, resolves itself into this: Does the after performance of the English locomotive cover the extra $4,000 of its first cost, or is that money thrown away in mere needless extravagance?

I was in hopes that this question would be solved this summer by an actual competition in running the world-famed Scotch Express; but I am disappointed, as many of your readers will be, to learn that the leading makers in this country have declined, on the ground that such a competition would not pay.

But, Mr. Editor, I claim that it would pay, and pay well. The type developed by that friendly comparison—and I am certain it would lead to further developments—would be well worth the trouble and expense incurred. I see that the committee of the Edinburgh exhibition have shown how mutual they expect the benefit of such a competition will prove by offering to share the expense of carrying it out.

American builders do a large trade with the Colonies,

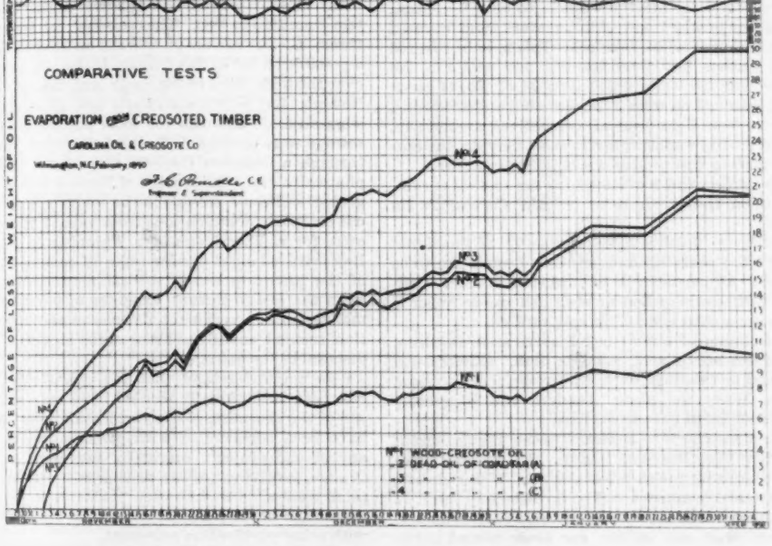
and if they can make better records on the run, which in all the Empire is considered unmatched in the world, the mere expense of sending locomotives over would be quickly covered.

Yours truly,

J. BERNARD WALKER.

[Neither American builders nor any other do a large trade in mile-a-minute locomotives, and that is not the rational way to determine the true merits of the different types. The argument based on the differences in early conditions is likewise based on a fallacy. Because on poor tracks only is the leading truck and equalizing lever indispensable, it does not follow that they are not on all tracks advantageous. They are so advantageous. All track is bad, just as all whiskey is good. It is only a question of degrees of badness. Therefore, on no track can these features be dispensed with which are not expensive and save shock and increase hauling power. That this is so is shown by the fact that while we have some thousands of miles of as good track as there is in the world, no one dreams of dispensing with trucks and equalizers on such track any more than on bad track. That our English friends at last see this is shown by the large and increasing number of engines having these features, which they are now building. They should have found it out before.

As for the superior conductivity of copper being a reason for retaining it, that is not the case. It is pure and unalloyed conservatism of the Chinese kind. The *internal* conducting power of copper is much the greatest, but its *receiving* and transmitting power in a boiler is sensibly the same as iron. M. PECLET's experiments showed this conclusively, and Mr. JAS. R. NAPIER made experiments with experimental boilers of iron and copper of various thicknesses, over a gas flame, which showed a difference of $\frac{1}{10}$ to $\frac{1}{20}$ only in favor of copper, confirming PECLET's results. All of which goes to show that broad generalizations of an *ex post facto* kind, like our correspondent's, are unsafe.—ED. ENG. NEWS.]


COMPARATIVE TESTS
EVAPORATION FROM CREOSOTED TIMBER
CAROLINA OIL & CREOSOTE CO
PERCENTAGE OF LOSS IN WEIGHT OF OIL
No 1 WOOD-CREOSOTE OIL
-2 DEAD-OIL OF COAL TAR (A)
-3 " " " " (B)
-4 " " " " (C)

Evaporation Diagram, Creosoted Timber.

Wood Treatment Tests.

WILMINGTON, N. C., Feb. 5, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—Some recent discussions on the value of creosoted material in connection with the evaporation of phenols from electrical conduits of wood "creosoted" with dead-oil of coal tar, have suggested a series of experiments to ascertain the comparative loss by evaporation, under ordinary atmospheric influences, of the dead-oil generally used for creosoting and of the true wood-creosote oil as now manufactured and employed exclusively for creosoting purposes, under the writer's supervision here.

These discussions have elicited the fact that the phenols (tar acids) of the dead-oil escaped from the wood and attacked the lead sheathing of telephone cables, forming a phenolate of lead, and to such an extent that it has been thought desirable to have such material exposed to the air or artificial means for evaporating the phenols, if the creosoting oil cannot be obtained without it, before placing the conduits underground, as after a few years this destructive agent disappears almost entirely or loses its potency for further mischief in this direction.

This early loss of a portion of the preserving agent, originally injected in the wood, has suggested another query of no small moment, akin to the infant's epitaph,

"What was I begun for,
If so soon I'm to be done for?"

as well as the expediency of the Hibernian idea to take out this elusive and worse than useless ingredient, before it is put in. The results of these experiments have thrown so much light on the question, of a surprising and somewhat unexpected sort, and are of such commercial significance as to warrant their presentation to the attention of engineers and others interested in the use of creosoted material.

The first series of tests have been made with three different samples of commercial dead oil, from as many barrels, obtained as average samples from leading manufacturers, and a sample of wood creosote oil taken from our working tanks in daily operation.

Four sets of wood specimens of two pieces each were prepared of kiln-dried North Carolina pine lumber, dressed, 4 ins. square and 13½ ins. long, and impregnated as nearly as possible with 12 lbs. of oil per cubic foot. They were then suspended side by side under shelter, and carefully weighed daily for ten weeks and weekly thereafter, having been subjected to exactly similar conditions throughout.

The results have been plotted on the accompanying diagram, each line representing the mean of the two pieces under test, the losses at the end of each week only being here tabulated, as follows:

No. 3.

LOSS BY EVAPORATION IN PER CENT. OF WEIGHT OF OIL INJECTED.

No. of sample	1	2	3	4
1st week	4.03	5.68	5.43	7.42
2d "	5.24	8.11	9.51	11.54
3d "	6.04	9.59	11.14	14.15
4th "	6.98	11.76	12.50	17.45
5th "	7.39	12.70	12.50	18.08
6th "	6.85	12.03	14.13	18.82
7th "	7.25	13.24	14.40	20.47
8th "	7.93	14.73	16.03	22.67
9th "	7.93	15.27	15.63	23.49
10th "	7.79	15.81	17.54	24.18
11th "	8.14	17.83	18.40	26.64
12th "	8.73	17.83	19.76	27.06
13th "	10.62	20.41	20.38	29.81
14th "	10.22	20.41	20.52	29.81
Ratio	1.	1.99	2.00	2.91

It will be observed that the loss was rapid for first few days, after which the rate was more or less influenced by atmospheric conditions, No. 1 having remained nearly stationary from the 5th to the 11th week, while the ratio of loss of the others continued increasing.

From this it appears that the 12 lbs. of oil originally injected have been reduced by evaporation to the following amounts:

No. 1, 10.77 lbs.; No. 2, 9.55 lbs.; No. 3, 9.53 lbs.; No. 4, 8.42 lbs., a result of much commercial significance as affecting the permanence of the the preserving agents in creosoted material.

Upon this basis the presence of say 10 lbs of oil per cubic foot remaining in the wood after such exposure to the air will call for the original injection of oil, as follows:

No. 1, 11.13 lbs.; No. 2, 12.56 lbs.; No. 3, 12.58 lbs.; No. 4, 14.24 lbs.; and for the presence of 12 lbs. per cubic foot as follows:

No. 1, 13.36 lbs.; No. 2, 15.07 lbs.; No. 3, 15.09 lbs.; No. 4, 17.09 lbs

Or, in other words, to secure equal effects on usual specification basis of creosoting with 12 lbs. of oil per cubic foot, there will be required an original injection of oil as follows:

No. 1, 12.00 lbs.; No. 2, 13.53 lbs.; No. 3, 13.55 lbs.; No. 4, 15.34 lbs.

The marked difference shown in the volatilities of the several oils indicated a like difference in their quality and composition, which has been fully substantiated by a careful chemical analysis and investigation of each separately, which also verifies the fact of the marked want of uniformity existing among the dead-oil samples themselves. This chemical investigation also serves to explain and support the experimental results given, as it discloses the several constituents of the different oils, and supplements the evaporation tests in a most satisfactory manner.

The following are the analyses of the several oils tested, arranged for ready comparison of their corresponding constituents and showing percentages by weight.

No. 5.

COMPARATIVE ANALYSES OF WOOD-CREOSOTE OIL (1), AND DEAD-OILS OF COAL TAR (2, 3, 4), EMPLOYED FOR CREOSOTING PURPOSES.

No. of sample.	1 per cent	2 per cent.	3 per cent.	4 per cent.
Water, mechanically contained	2.08	0.59	0.24	0.42
Water of decomposition	0.71	.....	.....	..
Indifferent oil, distilling below 534° F.	13.16	21.62	42.47	48.50
Crude creosote	17.00	.....	.....	.....
Tar acids	.....	9.72	15.34	16.63
Heavy oil, distilling above 534° F.	26.55	.....	.....	.....
Wax (paraffin resin)	25.97	.....	.....	.....
Naphthalene, etc.	.....	67.50	40.23	27.77
Coke	5.78	0.28	1.49	6.42
Loss	8.75	0.29	0.23	0.26
	100.00	100.00	100.00	100.00
And by volume,				
Distillate under 534° F.	26.00	77.00	61.00	78.00
Distillate under 600° F.	35.75	86.00	78.50	90.00
Residue under 600° F.	64.25	14.00	21.50	10.00

In comparing the relative percentages of the heavy and stable bodies it should be borne in mind that the coke and loss of No. 1 exist as heavy oil and paraffin in the wood-creosote oil which requires such a high temperature, during the final stages of distillation in the laboratory still as to decompose the oil to this extent. This relatively higher heat demanded with this oil is also naturally indicated by the much greater percentage of residue remaining undistilled at 600° F., and also by the water of decomposition produced.

The large percentages of the volatile tar acids and indifferent oils found in these dead oils, and of their distillates coming over under 600° F., naturally suggest some appropriate modifications of the usual form of creosoting specifications in these respects.

These analyses have been carefully made by FRANKLIN S. CLARK, E. M., Ph. D., and on the same line of investigation in every respect. The details of these experiments have also been made under the personal supervision of Dr. CLARK, who has had much experience in the operations of destructive distillation in general and the analytical investigations of wood products, on a commercial scale, in particular.

The results herein shown also confirm the importance and value of the recent improvements made in the manufacture of our wood creosote oil, and exhibit in a striking manner its superior qualities and value as a preserving agent.

We will now continue these tests with a duplicate series of similar specimens, for comparison; also with the different constituents of each kind of oil separately, and still others for solubility, the results of which will be awaited with interest. Yours truly,

F. C. PRINDLE, C. E., Eng. and Supt.

Notes and Queries.

X. Y. Z.'s query concerning the cubic capacity of cement barrels is answered by Mr. H. B. LEACH, of Woodbury, N. J., as follows: Keene's Portland cement circular gives the following for the capacity of the barrels used: weight, 400 lbs.; contains 3½ bushels; measures loose 4.25 cu. ft. Mr. C. J. PARKER, of Mauch Chunk, Pa., says that a careful measurement of the barrel used by the Coplay Cement Co. to pack "Improved Anchor" brand of cement shows a cubic capacity of 3.32 cu. ft. A common sugar barrel contains 5.55 cu. ft.

Standard "Overtrack" Station, Harlem Depression. — New York Central & Hudson River R. R.

(WITH INSET.)

On page 126 of our last week's issue we briefly described the new standard station on the Harlem depression of the New York Central & Hudson River R.R., of which a general elevation and sectional views were shown on our inset sheet. We this week give details of the construction of the building, showing very clearly the manner in which the chief novel feature of the design, the support of the floors from overhead girders, has been carried out.

The following are extracts from the specifications for the steel, iron, and brick work in the structure:

Skeleton, Frame Work, etc.—The skeleton of the building, which includes all rolled steel or iron work, shall be divided into structural and architectural iron work. The structural work shall be of open hearth steel as per standard specifications attached. All architectural iron work shall be of wrought iron as per specification following.

Standard for wrought iron.—Rivet iron to be neutral and to withstand cold bending 180° without fracture. All iron to be of uniform quality, neither hot nor cold short, and tough, showing a fibrous fracture. Small pieces to withstand a cold bending of 90° with a radius equal to 1½ the thickness of piece tested without cracking. Laboratory tests shall show 24,000 lbs. elastic limit and 10 per cent. elongation.

Workmanship (A. Structural Work).—Rivet holes to be punched. Rivets to be ⅞ in., upset to 1⅛ in. All rivets shall fill the holes after upset, and shall have good heads laid close up to a good bearing. Face the tops of posts and pedestals, and face the sole and sliding plates. Face or mill-saw the ends of main and other girders, and face or mill saw to exact lengths all rolled beams and channels. The holes in the long suspender angle-irons shall be marked and punched in the field.

(*B. Architectural Work*).—Punch all rivet holes except field holes, these to be drilled in place. Rivets to be ¾ in. generally, but for rafters, legs and verandah, ⅝ in. rivets will be used. Rivets to be driven at a red heat, and the holes shall be fairly filled, with heads large enough to grip the iron. Where the driving of rivets is difficult, bolts may be substituted for rivets under direction of the engineer.

Standard Specifications for Structural Steel.—(1) The steel will be "open hearth," of a make approved by the engineer. All steel to be free from laminations and injurious surface defects. Pieces cut lengthwise from shapes, bars and plates, of such size as the engineer shall determine, to have an ultimate tensile strength of not less than 55,000 lbs., and not exceeding 63,000 lbs., per sq. in., with an elastic limit of not less than 34,000 lbs. per sq. in., an elongation of not less than 25 per cent. in 8 ins. in length, and a reduction of area of 50 per cent.

(2) Each piece of shape, plate or bar steel to withstand such punch and forge tests as may be sufficient to test the temper, soundness of material and fitness for service, the tests to be applied to the shearings. For metals ½ in. thick or less, a row of ⅞-in. diameter holes, pitched 1½ in. centers, or a hole pitched ¾ in. from edge, shall not cause cracks in plates or shapes. Strips cut lengthwise 11½ ins. wide, heated uniformly to a low cherry red, and cooled in water at 82° Fah., must stand bending double, and close down flat under the hammer without cracking.

(3) The steel for rivets shall have an ultimate tensile strength of not more than 54,000 lbs. per sq. in., and a reduction of area of 60 per cent. Test rivets heated to a red heat and upset for 3 ins. of metal shall show (upon cutting out) no crystalline appearance.

(4) All tests above shall be made at the mills under direction of the engineer. The contractor shall provide the material for testing, and bear the expense of making the tests.

(6.) The engineer reserves the right to inspect all steel at the furnace, such inspection to cover the process of manufacture only.

(7) Tests shall be made on pieces cut from plates, bars and shapes of such size as the engineer shall determine and no tests shall be made on round pieces except for rivet steel.

Brick Arching.—Brick arches, laid rowlock fashion, breaking joints in proper shape, will be laid between iron I beams, and they will be started on proper skew backs cut out of brick and bedded in clear cement mortar, or on cast-iron skew backs specially prepared. All brick is to be selected hard burnt of best quality, laid in clear cement mortar, this to be mixed in the proportion of one part cement to two parts of sand. Brick to have a thorough wetting at time of laying. The space between the I beams above the arch will be filled to the level of underside of I beams with cement concrete prepared in approved manner.

By reference to the drawings the manner of supporting the floor beams from the overhead cross girders by means of angle suspenders may be clearly seen. Girders *G*, *E*, and *D* are of steel, of 68 ft. 6 in. clear span, and are supported on the retaining walls at either side of the depressed tracks. Girder *G*, at the extreme back of the structure, rests directly on the retaining walls. To have placed girders *D* and *E* in this position would have been impossible, as there was not sufficient head room for such deep girders beneath the floor. They were, therefore, placed overhead, and supported at their ends by columns resting on the retaining walls. Cross girders about 5 ft. deep are framed to these longitudinal girders, and from these angle-iron suspenders are carried down to support the floor beams. The small roof truss of the back gable is carried by columns resting on the girder *G*.

The structure seems to be a solid one in every way, and its vibration, even when trains are passing, will probably be little more perceptible than that of a building resting on ordinary foundations. The street bridge adjoining the station is not connected with it by any framing substantial enough to communicate vibration.

The following further details of construction we condense from the specifications:

The floor beams are to be 3 × 8 ins. and 3 × 10 ins. laid crosswise of each other, The flooring is to be of edged grain yellow pine 3 × 1½ ins., matched and blind nailed to an under flooring of white hemlock. The latter is to be nailed to joists not more than 6 ins. wide.

The studding for the walls is to be of 3 × 4 ins., spruce or hemlock, set 16 ins. centers, and covered with siding of white hemlock. This is to be covered with Anchor brand roofing felt laid with 2 in. lap joints, and the outer finish is to be of No. 14 sheet iron, fastened on with ⅞ in. stove bolts, spaced 8 ins. apart. New York Central locomotives are not supposed to throw sparks; but in case they do, the outside plating will protect the building from fire.

The rafters and roof sheathing are to be of spruce, and upon the latter is to be laid Cortright's tin plate.

The inside finish is to be principally of quartered oak; office shelving and window frames are to be of ash. All hardware is to be of solid bronze. Ceilings will be of panelled spruce. All inside finish is to be done with wood filler and hard oil.

The chimneys are to be of stove plate cast-iron. The stairs are to be of wrought iron. Gutters will be lined and flashed with Gilbertson's old method extra heavy tin plate. Leaders will be spirally joined of No. 24 galvanized iron.

The plumbing is to conform to the regulations of the New York Board of Health. All exposed pipes are to be packed with mineral wool. Water closets, urinals, and lavatories will be furnished by the J. L. Mott Iron Works. Two ventilators, 2 ft. in diameter, covered with oak lattice, are to be placed in the ceiling of the waiting room. The following is taken from the specifications for the gas-piping:

Mains must be as direct as possible. All pipe must be so graded as to allow the water to run out at a convenient point near the meter, where suitable drip cocks are to be provided. The following table gives standard sizes of piping required:

Size of tubing; ins.	*Greatest length allowed; ft.*	*Max. No. of burners.*
⅜	20	3
½	25	6
¾	40	20
1	60	30
1¼	100	60
1½	150	100
2	200	200

For transferring baggage from the rooms on the first floor to the platforms beside the tracks, a Reedy improved sheave platform elevator is to be provided at each side. They are worked by a hand rope running over a wheel 4 ft. in diameter on a 2-in. shaft, running in bronze roller bearings. The pinion on this shaft is of cut bronze and it engages with a cast-iron cut gear, 24 ins. diameter and 3 ins. face. These elevators cost $265 each.

The first of these new stations to be built will be the one at Melrose, proposals on which are now being received from contractors.

As stated in our last week's issue, in this case the "overtrack" station was the only available type; but there is no lack of localities where the conditions are in many respects similar, and it has been preferred to maintain separate stations, one on each side of the depressed tracks. Local peculiarities may sometimes make this a more economical type; but while it will generally be cheaper in first cost to build the separate stations, the tendency to dampness in a building set below the ground level, and the larger staff required to attend the separate stations, will be apt to make the "overtrack" station considerably the cheaper in the long run.

The East Orange Disposal Works: Their Efficiency as Compared with Other Methods.*

BY CARROLL PHILLIPS BASSETT, M. AM. SOC. C. E., ENGINEER OF THE WORKS.

When the township of East Orange began the discussion of available systems of sewage removal in 1883, they came face to face with a problem new to municipal development in this country. Serious obstacles to a collection of the sewage, due to topographical peculiarities, existed, but these problems were almost forgotten in a search for a satisfactory outfall for the collected domestic and manufacturing wastes.

Bordered by Newark, Orange, South Orange, and Bloomfield, supplied with excellent water, and provided with many miles of substantial Telford pavements, East Orange was enjoying an era of most prosperous growth; but every rise in the wave of municipal prosperity made more urgent the effective removal of voided and discharged wastes.

How was this to be accomplished? Where were the wastes to be discharged? These were the questions propounded before many a public meeting, and many times to committees in power during the winters from 1883 to 1886. The possible methods were three: (1) The sewers of Newark on the east offered a possible outlet to the Passaic River; (2) pumping over the high ridge to the south and thence to the Newark Bay between Newark and Elizabeth was suggested; (3) schemes for local purification of the sewage were presented. To the first project Newark, through a Common Council Committee, said emphatically, No. The sewage of Newark was of itself giving sufficient trouble in the water supply without accepting contributions from beyond its limits, even for a liberal subsidy. Pumping to Newark Bay involved eight or nine miles of conduit outside of the township across several municipalities, besides the heavy current expenses of pumping and maintenance. Argument, discussion and investigation seemed equally to favor some method of local disposal of the sewage.

I do not understand that the title of this paper has been intentionally worded to secure a comparison of the operation of the purification works which have been constructed with possible results with any of the projects originally suggested in East Orange, involving a crude discharge of sewage into tidal waters. The intention rather is to compare the results of the purification process here adopted with other purification processes.

Nor is this an easy task. For it may be stated with perfect assurance that no system of sewage purification has been constructed in this country up to the present time which is competent to do the work, under similar local conditions, which the East Orange plant was designed to accomplish. Small available area of land in the midst of a dense suburban population, and a high grade of chemical purity in the effluent from the works, which flows into a small tributary of the Passaic River close to the water supply intakes of Jersey City and Newark: these were the conditions which the works were designed to meet.

The aim of this paper will be to give in outline an accurate account of the success and shortcomings of the works as constructed and operated, and then outline the conditions under which the principles involved may be introduced with advantage into new work. A brief explanation of the system will be of service. For further description and plans of the works, see ENGINEERING NEWS for January, 1889.

The sewage enters the works in a 2 ft. x 3 ft., new form, egg-shaped, brick sewer, and enters a conduit of rectangular section having lateral projections extending nearly to its centre on alternate sides at intervals of 3 ft. along the axis.

In this conduit chemicals from the building enter the sewage; the lateral projections of the carrier give a whirling motive to the sewage, which causes a complete mixture of the chemicals with it. The carrier now leads the sewage to the precipitation tanks. The tanks are constructed in duplicate, one

* A revision of an article read before the New Jersey Sanitary Association November 1889.

set being cleaned or lying idle while the other is in use. A brick wall, located 10 ft. in front of the inlet to the tanks, checks the velocity of entrance flow. A board on edge in vertical guides intercepts the lighter floating matter and insures its saturation before passing it. The cross-walls in each tank divide it into three compartments; over these the flow passes with a depth of about 2 ins., the heavier matters settling and being intercepted. With a continuous flow of low velocity in the tanks the surface water is being constantly skimmed off into the carrier. Drums float a swivel arm in each compartment which connects with a low service pipe in the bottom of the tanks and discharges on the surface of the ground at a lower level. These arms draw water only from the surface, but the drums falling with the water enable any arm to empty the compartment in which it is located into the low-service carrier leading to the surface of the ground.

The effluent from the precipitation tanks, after entering the carriers, is distributed over the service of the filtration ground, and descends to the under drains, which are from 3 ft. to 5 ft. deep and 20 ft. apart over the entire 14.7 acres in the works.

The sewage effluent is applied to the land on the principle of intermittent downward filtration, the flow being applied successively to different areas. Part of the land is laid off in beds 4 ft. wide separated by shallow furrows in which the water flows, soaking laterally into the beds. The remainder of the land is divided into flat beds, 100 ft. long by 50 to 100 ft. in width, over the whole of which water flows. This latter method is preferable where the coarser matters are removed from the sewage before it passes on to the land. Italian grass has given the best results on the land and is now grown almost exclusively. Farmers from the neighborhood cut the grass and remove it as necessary, but up to the present time the town authorities have not been able to secure a satisfactory return from its sale.

Returning now for a more detailed examination of the steps in the process of purification outlined above. At present about 2.5 grains of lime and 1.0 grains of sulphate of alumina are added to each gallon of sewage entering the works. The sewage is highly diluted with a large flow of ground water taken into the 27 miles of sewers in the township (more than 13 miles of which are constructed in a saturated subsoil) but the quantity of chemicals is much less than is ordinarily used and less than was recommended to the committee by me as desirable. Weighed quantities of lime and alumina are placed on perforated plates near the bottom of separate cast-iron vats, into which sufficient water is admitted from the street main, and compressed air is then blown into the bottom of the vats, causing a violent ebullition of the water, resulting in the rapid and effective solution of the chemicals. The outflow of chemicals to the sewage is regulated by gate valves; a gauging of the sewage flow determining the draft from the vats.

Mention has been made of the unusually large percentage of the sewers throughout the township which are under water pressure. The intricate topography of the town made several heavy cuts, in some cases over 30 ft., necessary. In all these deep cuttings the water level is now far above the sewers, a head pressure of over 20 ft. occurring in several places. In addition, all the mains located in the valley lines were constructed in a quicksand or running sand formation.

Under these circumstances, despite the greatest care and much expense, a considerable volume of ground water finds its way into the sewer pipes. When it is remembered that there are over 2,600 joints per mile, some of them over six feet in circumference, the practical impossibility of making actually impervious sewers under the conditions named with vitrified pipe and cement becomes apparent. But this flow from the 25 miles of pipe sewers was limited to a very small volume—probably about 2.5 galls. per second.

It was necessary, however, to build the outfall sewer with a size beyond the maximum vitrified pipe, and a brick sewer was therefore constructed for 2,000 ft. through a difficult formation, a timber cradle being used under the sewer. A large addition of soil water enters this sewer.

In another section of the town a tunnel, at a depth varying from 25 to 35 ft., was driven for about 2,500 ft. to avoid the interference with surface travel incident to so tedious a work in open cut. The great difficulty experienced in controlling the large volume of water encountered at this depth practically prevented the construction of an impervious sewer in this place, where the tunnel was lined with brick.

From these two pieces of brick sewer less than a mile in length about 5 galls. per second enters the sewers; twice the quantity, it will be noted, entering the remaining 25 miles of pipe sewers.

This aggregate flow of 7.5 galls. per second, 65,000 galls. per day, mingles with the house sewage (about an equal amount), becomes sewage, and must undergo the purification processes.

To relieve the filtration grounds, which have rather a retentive soil, from the heavy tax of passing this million and a quarter gallons per day, several artificial filter beds of coke and gravel were constructed, and have been of material service, performing the work excellently.

Where the dual processes of chemical precipitation and land filtration are employed, a decrease in the efficiency of the former causes an increase in the labor of the latter. On account of the small amount of chemicals used at the works as given above, the coagulation and precipitation in the tanks is much less effective than could be secured at an added cost, and the land is called upon to do more than its equitable share of the purification as originally planned.

I have nothing at present to do with the management of the works, they having been turned over to the authorities last spring, but I understand that the committee having the works in charge are satisfied with the present results obtained with the small amount of chemicals mentioned. It should, however, be understood that much more efficient precipitation may be secured when it is deemed desirable.

As the sewage enters the tanks, matters in suspension by their own gravity tend to deposit. This tendency is fostered by the arrangement of cross walls and floating interceptors.

The coagulated film formed by the chemicals entangles finer suspended particles, and, enticing other matters from solution, settles or is precipitated in the tanks. Over 75 per cent. of the matters separated from the sewage in the tanks is deposited in the tanks nearest the sewer outfall.

The effluent water from the tanks is spread out over the surface of the ground in thin streams. The processes of purification there at work may be summarized as:

1. Absorption by vegetation of manurial matters.
2. Mechanical filtration by the soil.
3. Minute subdivision of the water in the pores of the soil with resulting oxidation or combustion of organic matter.
4. Nitrification or tearing apart complex organic forms by microscopic life found near the surface of the soil.

Returning now to the precipitated matter or sludge in the tanks: after the supernatant water is drawn off through the swivel-arm, a valve gate is opened and the sludge drawn into the deeper sludge well within the building. By forming a vacuum in a cast-iron receiver, which is connected by an iron pipe with the sludge well, the sludge is forced up into the receiver; milk of lime being drawn in at the same time by a small pipe from a mixing tank similar to the chemical vats. This lime prepares the sludge for pressing, cutting it so that the water separates more readily from the solids. A pressure of 100 lbs. per sq. in. is secured in another of the three receivers, and being connected with the receiver containing the sludge by an air transfer main, and the proper valves opened, the sludge is forced into a Johnson filter press and pressed into moist hard, portable cakes.,

The filter press consists of 36 cast-iron cells, supported on a simple frame, with a central feed passage into which the sludge is forced from the receivers. The cells are separated by canvas bags and in the intercellular spaces the sludge remains while the water is strained out through the canvas into a trough on the rear of the press and returns to the tanks. On the end of the press is a capstan screw connected with a thrust block which presses the 36 cells into close contact. It is the air pressure which separates the water from the sludge.

There is nothing offensive about these cakes when pressed dry; and if protected from moisture when taken from the press they may be kept in bulk for weeks without nuisance.

At present between 6,000 and 8,000 people are contributing to the sewage, and about 10 tons of sludge cake are taken out each week. Some of the sludge cake has been sold at 50 cts. per load, but more has been given away, in hope of creating a demand for it among neighboring farmers, while a large amount has been carted away by the authorities when no other removal offered.

The machinery used in manipulating the sludge is the subject of several patents, and was constructed by S. H. Johnson & Co., of England. No similar devices are manufactured at present in this country.

No well-founded complaint has been raised against the works since they were placed in practical operation, although they are closely surrounded by dwellings. Naturally, however, objection exists in the minds of some to the "suggestiveness" of the works, and for this reason considerable pains were taken to make both the buildings and grounds attractive to the eye. They are pleasantly referred to by the residents as "Franklin Park." [A reference to the drawings of the buildings published in ENGINEERING NEWS, as above referred to, will show that they are extremely neat.—ED.]

The expense of maintaining the purification works is about 60 cts. per head of contributing population; this amount may be somewhat reduced when a larger part of the town's population is connected with the sewers.

Experiences with these works and a knowledge of existing conditions elsewhere give rise to several practical conclusions.

Sewage purification is perfectly practicable on a large scale; the difficulties which arise in regard to it are objections to its expense.

Sewage purification is a burden which municipalities should be taught to bear when their location requires it. Human nature in inland communities in no particular differs from that among coast populations, and it may be relied upon, if left to itself, to shift the evil of sewage discharge from its own door to the threshold of its neighbor. The evolution of the intricate relation of rural well and cesspool has produced the less concealed connection of sewer outfall and municipal water supply—a development truly worthy of its prototype. Nothing but the power of the law can restrain this "touch of Nature."

The anomalous mixture of sewage and potable water may be seen everywhere throughout the thickly populated portions of the country, and yet but small efforts are exerted to prevent it. The laws throughout the country relating to the pollution of streams are almost, without exception, signally weak or inoperative.

But what are the conditions under which purification of sewage becomes desirable? The question does not interest alone the town seeking the outlet; it involves most frequently the substantial interest of other peoples. But who is to decide upon the needs of purification or the merits of a crude discharge, under varied conditions? Can this be safely left to the interested population? In a recent suit before the Chancellor of New Jersey, Passaic City set up the claim that should its sewage be turned into the Passaic River *four miles* above the intake at Newark's water supply, its dangerous properties would be so far destroyed that Newark's population could safely drink it; and there were evidences in the decision, which favored Passaic, that the claim was not entirely discredited.

Drs. LETHEBY, ODLING, and others in England have asserted that, if the dilution is at least 20 times the volume of the sewage, the organic matter will be rapidly oxidized, and will be entirely destroyed in a dozen miles or so. The English River Pollution Commission, however, stated in 1878 that there was no river in England long enough to completely destroy sewage matter discharged into it. Some considerable "personal equation" must be allowed in these results, and a middle ground is more defensible than either extreme.

Subsidence, dilution, and aëration, and the attacks of living agents will do much to counteract pollution in streams; but can we safely trust Nature to do all the work that our compact civilization is laying upon her? Some streams now used for water supply must undoubtedly be given up to become natural drainage and sewerage channels. But who is to decide upon the streams?

Of some few things we are reasonably sure.

Every gallon of filth taken out of a stream makes its purification by natural means so much easier, and streams receiving only purified sewage effluents in place of crude sewage would have far less difficulty in digesting and eradicating the dangerous elements now threatening.

Along streams used as public water supplies and at the same time as outlets for sewage, requirements of purity in the sewage effluents should be established in accord with the results of available processes, and, where necessary, populations required to subject their water supply, taken from such a stream, to a process of artificial purification.

Potable streams should be defined and classified; and, when a complete examination of any watershed indicates that a stream or any part of a stream should for any reason be finally abandoned as a potable supply, provision for a proper supply for the populations using such a source should be made, and ample notice given that they may effect the needed changes.

If such a policy were inaugurated, radical improvements in present methods of sewage and water purification to meet the added needs would certainly follow. The extra expenses incident to the plan would be amply justified in a saving of life and an increase of efficient and vigorous health. And in this particular it may be stated that the sanitarian never fears a fair comparison of the cost of removing unsanitary conditions with the cost of retaining them.

A review of the legal decisions against river pollution even under present imperfect laws shows that the courts are in the main emphatic in protecting a public water supply. And, although comparatively few actions have been taken, considering the very general practice of stream pollution, it seems probable that in the near future the subject will receive more of the attention which it merits.

Testing the Forth Bridge.

A further step in preparing for the opening of the Forth Bridge was taken on Jan. 21, says *Engineering*, when the engineers tested the structure for deflection. To this end, two trains, each consisting of two engines ahead, followed by fifty coal trucks, with a third engine at the tail, were got ready, and moved on to the bridge. The engines were of the heaviest type, weighing with their tenders about 72 tons each. The coal trucks were intended to weigh 13½ tons each, but owing to a fall of snow their weight was somewhat greater, and the total weight of the trains reached fully 900 tons each. Close buffered each train measured 998 ft. 9 in. in length, and loose buffered 1,040 ft. Careful arrangements had been made previous to the test for ascertaining the deflection of the structure, both vertically and horizontally, and all was ready for the observations to be made when the trains were moved on to the bridge at a walking pace, and side by side from the south shore of the Forth. The trains were stopped when the leading engines were a little more than half way across the south central connecting girder, which is the most unfavorable position for loading the North Queensferry cantilever, and a series of levels were then taken. After this had been done the trains were moved on to the corresponding position on the north central girder, when another series of levels were taken. Finally the trains were moved forward until the engines were just within the vertical columns of the Fife pier. As it had been arranged that no train should cross the bridge before Jan. 24, when the directors were to have the honor of first crossing the structure, the two trains went no further, but were backed on to the south approach viaduct, and further levels taken. It is not known what the actual amount of the deflection was, but according to report of the engineers the measured and calculated results are in exact accord. The following is the official account of the test:

Sir John Fowler and Mr. Baker, engineers of the Forth Bridge, have to-day (Jan. 24) tested the two 1,700 ft. spans by placing on the centers two trains, each made up of 50 loaded coal wagons and 3 of the heaviest engines and tenders, the total load thus massed upon the spans being the enormous weight of 1,800 tons, which is more than double what the bridge will ever be called upon in practice to sustain. The observed deflections were in exact accordance with the calculations of the engineers, and the bridge exhibited exceptional stiffness in all directions.

Still earlier in the week, on Jan. 19, the bridge went through another test, which, though the engineers had nothing to do with it, was of equal importance to the last. On that day the wind gauges on Inchgarvie registered a pressure of 37 lbs. per square foot, the heaviest wind load the completed structure has yet experienced, and under this the maximum lateral deflection of the cantilever was less than 1 in. Arrangements are now being completed for the opening of the structure by the Prince of Wales on March 4 next, all the details for which are being carried out under the personal superintendence of the engineers.

The Atlantic & Danville Railway.

In April, 1882, the Atlantic & Danville Ry. Co. was incorporated in Virginia for the purpose of building a line of railway from the seaboard at Norfolk and Portsmouth, Va., west to a connection with the lines of Eastern Tennessee and Kentucky. The plan also included a line from Claremont to Bellfield, Va., 55 miles. This branch was completed during the next three years, it being opened for traffic in 1885. From this time nothing was done in the way of construction until 1888. During that year work was commenced on the main line, and the division from Norfolk west to Lawrenceville, Va., 95 miles, was completed. Work was continued all through 1889, and early in the present year the line was completed to Danville, Va., and it was opened for traffic on Jan. 23, with appropriate ceremonies. The length of the line now completed is about 270 miles.

In July, 1889, the Danville & East Tennessee R. R. Co. was chartered to complete the line to Bristol, Tenn., where connection will be made with the East Tennessee, Virginia & Georgia R. R. Surveys are now in progress, and it is probable that the work of construction will soon begin.

The prospects for a paying business for the extension seem good. The route is through a country now having no east and west lines, and connections are made with the most important systems in the South. An important factor in the business will be the mineral traffic from southwestern Virginia and eastern Tennessee to the Atlantic coast, and in this the road will have a slight advantage over its competitors on account of a somewhat shorter route. The company owns large wharves and other terminal facilities at Norfolk. The officers are: President, THOS. EWING; Vice-President, CHAS. B. PECK; Secretary, BENJ. L. FAIRCHILD, and Treasurer, A. E. BATEMAN.

The Fire Defenses of Paris.

Mr. W. L. BOSWELL, who went to the Paris Exposition of 1889 as a delegate of the Franklin Institute, of Philadelphia, has made a report to that body on the fire defenses of Paris, as compared with those of American cities. As it is somewhat the fashion to ridicule the fire appliances of Continental cities, and they do seem absurd to the American traveler, Mr. BOSWELL's notes are interesting.

He first considers the necessity for such appliances abroad as we are familiar with. He finds that in 1888 there were 923 fires in Paris, as compared with 762 in Philadelphia, and the gravity of the loss is compared as follows:

Fire loss in Philadelphia	$2,128,155
" Pennsylvania	5,102,402
" United States	
Insurance loss	52,677,896
Total loss	119,200,380
Fire loss in Paris	1,322,742

The average annual fire loss in the United States for the past 13 years has been $90,000,000.

From an examination of data Mr. BOSWELL finds that in proportion to population fires are twice as numerous in Philadelphia as in Paris, and four times as destructive; and as this average holds good for the whole United States, the same rate of frequency and gravity applies to the whole country.

The writer, in accounting for the comparative immunity of Paris, ascribes this to the substantial character of the buildings, the strong partition walls in buildings, the care specifically taken to prevent fire, and to the fact that in Paris stores and dwelling houses are not so widely separated as with us. Another advantage in Paris is the very complete distribution of fire apparatus, which makes it practically impossible for a fire to continue any length of time.

Water is used in small quantity at a Paris fire as compared with the floods we throw upon it. The chief reliance is in buckets, of which the fire department has more than 10,000. In 1888 buckets alone were used in extinguishing 698 fires out of 923; steam engines were employed only 37 times. In fact, there are only 12 steam fire engines in Paris; whereas, in proportion to the population and our fire engine distribution, Paris should have at least 100 steam fire engines.

All parties insured in Paris must give to the proper authorities, within 15 days after the fire, a full account of: (1) Day and hour of fire; (2) its duration; (3) its cause; (4) means used for extinction; (5) all circumstances about it; (6) nature and extent of loss. In Paris also, the landlord is responsible for loss to the tenant, if it can be proved that the fire is due to some defect in the construction or maintenance of the house. But the tenant is also responsible to the landlord for any negligence on the tenant's part, causing fire. Then, again, the party on whose premises the fire occurs is responsible to his neighbors on both sides for any loss they may incur as a consequence of the fire. These regulations are rigidly enforced in Paris; and as the French insurance covers not only one's own property but also these additional liabilities, no sympathy with the insured interferes to prevent the course of justice.

Discharge over a Weir.

Under the auspices of the French Government, a series of experiments on the discharge over a weir were made by M. H. BAZIN, by whom a paper, containing his preliminary results, has been presented to the Académie des Sciences, and this is noted as follows in *Engineering:* In conducting these experiments a standard weir, designed so as to reduce to a minimum such disturbing influences as width of edge, lateral contraction, and velocity of approach, was first erected, its length being 0.57 ft., and its height 3.7 ft. This weir was carefully calibrated for heads ranging from 0.16 ft. to 1.31 ft., and the coefficient m determined from the equation:

$$Q = m\, l\, h\, \sqrt{2gh}$$

This coefficient was found to vary with the head, its value ranging from 0.449 to 0.426, the minimum value occurring with a head of between 0.65 ft. and 0.82 ft. Having obtained a series of these values, M. BAZIN now proceeded to determine the flow over weirs with heights of 2.45 ft., 1.64 ft., 1.15 ft., 0.79 ft. respectively, the velocity of approach now being no longer negligible, with the result that the equation

$$Q = m\, l\, h \sqrt{2\, g\, h}$$

was still applicable, where

Q = discharge per second in cubic feet,
l = length of weir in feet,
h = head over weir in feet,

and m being given by the equation:

$$m = M\left(1 + 0.55 \frac{h^2}{(h + p)^2}\right)$$

where

M has an average value of .42,
h = head in feet.
p = height of weir in feet.

The Treatment of the Sewage of Frankfurt.

According to the *Zeitschrift fur Transportwesen*, the present works have been in operation since July, 1887. The sewage is first purified by the addition of milk of lime and sulphate of alumina. The managers of the works have been constantly endeavoring to find better precipitants than those mentioned, but they have not yet succeeded. Different combinations of milk of lime, iron salts, phosphates, and other substances have been tried in vain.

Chemical and medical investigations show that the effluent as now obtained is reasonably pure and without any organic matter, while the sludge is of some value. From 32,700 to 39,240 cu. yds. are treated daily with perfect success.

The sludge is pumped from the precipitating tanks to specially prepared basins, where it stands, becom-

ing thicker through the action of the wind and by draining. A large part of this product is taken away in this state by the neighboring farmers for fertilizing purposes, to which it is well suited.

In August, 1889, a contract was made with the director of a large farm in the vicinity, by the terms of which he is to have about half of all the precipitates of the next five years. These precipitates will be carried in boats designed for the purpose to the places on the Main River where they are to be applied.

The sludge contains 2.4 per cent. of nitrogen, 2.6 per cent. of phosphorus, and 0.9 per cent. of calcium. Investigations are in progress to find out if this product cannot be made into a high class fertilizer. At present it is worth about 35 cents a cubic yard.

No complaints have been made as yet against the works on account of disagreeable odors or for any other reason.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Lehigh Valley.—The annual report of this company for the last fiscal year shows the following results from operations:

Gross earnings	$16,674,964
Operating expenses	11,419,383
Net earnings	5,255,581

The President in his preliminary statement says:

In addition to our terminal properties at the Morris Canal Basin, we have acquired interests in other valuable water-fronts at tidewater on New York Bay, and are extending our line from Roselle through Newark to make these properties available for our rapidly growing freight traffic, as well as to provide additional facilities for the shipment of coal in the harbor of New York. Our main line, through the purchase of the Geneva, Ithaca & Sayre R. R., and the extension to tidewater, as stated, now extends from Jersey City to Geneva, distant 97 miles from the terminus of the L. V. Ry. at Buffalo. The Buffalo & Geneva Ry. Co. has located its line between three points, and has under contemplation its early construction. . . . The Schylkill & Lehigh Valley R. R., extending from the mouth of Lisard Creek, about 40 miles, to a point on the west branch of the Schuylkill River near Tremont, has been under construction since last spring. The grading will be completed within these or four months, and the road opened for the active coal season of the present year, enabling us to reach valuable coal developments which will be tributary to this line.

West Jersey.—The Alloway & Quinton R. R. branch from this road is now being surveyed. It will be about 5 miles long and is being built to open up large factories and other property at Quinton.

Mt. Penn Gravity.—The grading on this gravity road at Reading, Pa., has been completed and only about ½ miles of track remains to be laid. The road is 8¾ mile long.

Toledo, Columbus & Cincinnati.—This company expects to open the division from Kenton to Findlay, O., 23 miles, completed last year, for traffic Feb. 15. Work is being pushed rapidly towards Columbus, and it is expected that the entire line will be completed by June 1.

Western Maryland.—It is announced that this company has decided to build an extension from York, Pa., to a connection with the Philadelphia & Reading R. R. near Harrisburg.

Concord & Montreal.—It is announced that work, will be commenced at once on the Franklin & Tilton R. R. running from Franklin to Tilton, N. H., 4¼ miles.

Philadelphia & Erie.—The annual report of this company for the last fiscal year shows the following results from operations:

Gross earnings	$4,689,137
Operating expenses	2,910,564
Net earnings	1,778,573

Lake Shore & Michigan Southern.—It is stated that this company is making surveys for a branch from Allegan, Mich., to Laporte, Ind.

Pittsburg & Lake Erie.—Work will soon begin laying a second track from Coraopolis to Beaver, and from Hoinewood to Youngstown. Work of double-tracking the Pittsburg, Mckeesport & Youghiogheny Ry. has been commenced. When these two sections are finished the road will be double-tracked from Mckeesport, Pa., to Youngstown, O.

Delaware, Lackawanna & Western.—The annual report of this company for the last fiscal year shows the following results from operations:

Gross earnings	$38,247,621
Operating expenses	30,653,585
Net earnings	$7,594,036

Projects and Surveys.

Kettle Creek.—Incorporated in Pennsylvania to build a line of railway from Westport to Trout Run Village, in Clinton County, Pa., a distance of 14 miles. Edgar W. Munson, of Williamsport, Pa., is President.

Sault Ste. Marie, Quebec & Atlantic.—This company is seeking incorporation from the Quebec Legislature to build a line of railway about 500 miles long. It is to start from a point on the left shore of Ottawa River, between the mouth of Rivière du Moine and that of the outlet of Lake Kippewa, run eastward in a straight line through the districts of Ottawa, Terrebonne, Joliette, Three Rivers, and Quebec, pass by the City of Quebec, and continue by Beauport, to cross over the St. Lawrence at the Island of Orleans, and to reach the south shore of the river at or near the environs of Pointe à la Mortinière, thence run to the southeast through the districts of Montmagny, Kamowraska, and Temiscouata, and end at the Temiscouata main highway in the neighborhood of the frontier, with a branch line starting from the main line at some point in the county of Kamowraska, passing north of the Lake Temiscouata, through the districts of Rimouski, Bonaventure, and Gaspe to the port of Gaspe. Among the projectors are: J. A. Langlois, N. Lavoie, and J. E. Bailey, all of Quebec.

Rockland, Rockport & Camden.—This Maine company has made a proposition to the city of Camden to build the proposed line from Rockland to Camden, Me., 8½ miles, on condition that $40,000 be subscribed in aid of the enterprise by that place. The matter is to be voted upon at the coming March meeting.

Cumberland & Washington.—This company has been organized in Maryland to build a railway from Cumberland, Md., to Washington, D. C., and to acquire the Chesapeake & Ohio Canal for the roadbed. The capital stock is $2,000,000. Among the incorporaters are: Enoch Pratt, of Baltimore, Md., Asa Wilson, of Cumberland, Md., and Martin N. Rohrbach, of Washington, D. C.

Verona Valley.—A number of the leading citizens of Caldwell and Verona, N. J., have organized a railway company to build a line of railway from Cedar Grove, on the New York & Greenwood Lake R. R., southwest along the Verona Valley toward Roseland, about 4½ miles. The road is to be equipped and operated by the New York & Greenwood Lake R.R. Among the projectors are: Geo. B. Harrison, G. Jefferson, J. L Johnson, and Lewis G. Lockwood.

Gunpowder Valley.—This company has been incorporated to build a railway from a point on the Baltimore & Harrisburg R. R. one mile north of Alesia to Rockdaleville, Md. Among the incorporators are: W. E. Hoffman, G. M. Fultz, and J. D. Shearer.

SOUTHERN.—Existing Roads.

Belt Line.—W. T. Joseph, President, writes us that this road at Montgomery, Ala., will be opened for traffic as soon as the locomotives arrive. The road was built by private subscription and will do a freight business only.

Cape Fear & Yadkin Valley.—Tracklaying has been completed on the extension from Fayetteville to Wilmington, N. C., and the road will be opened for traffic shortly.

Alabama Midland.—About six miles of the Montgomery, Tuscaloosa & Memphis R. R. have been graded, and the rails are now being delivered.

Gulf & Ship Island.—A bill has been introduced into the Mississippi Legislature declaring the forfeiture of the land grant in aid of this enterprise.

Columbia, Newberry, & Laurens.—Work is making rapid progress on the division from Columbia to Newberry, S. C. The new iron bridge over Broad River is completed, and rails have been laid by means of hand cars to a point about a mile beyond. Engines being now allowed to cross the bridge, the tracklaying will henceforth proceed at the rate of nearly a mile a day. The cross-ties have been placed on from 15 to 20 miles of road bed, and the steel rails for the 43 miles of line to Newberry are all on hand.

The road will be pushed on from Newberry to a junction with the Georgia, Carolina & Northern as soon as possible.

West Virginia, Pineville & Tennessee.—Construction is reported begun on this road which is projected to run from Pineville, Ky., east along the foot of Pine Mountain on the north side to the Breaks of Sundy, and from Pineville south to the Tennessee State line. The route is through a very fine mineral region.

Norfolk & Western.—This company has advertised for bids for the construction of the division from Elkhorn, W. Va., to Ironton, O., 195 miles. The bids will be received until Wednesday, Feb. 26.

Louisville, Hardinsburg & Western.—Tracklaying on this road is progressing rapidly. Thirty miles of the line from Irvington toward Fordsville is now completed.

Charleston, Cincinnati & Chicago.—Johnson City, Tenn., has extended the time in which this company can earn the $75,000 subscription voted in its aid to May 1.

Chattanooga, Rome & Columbus.—A report is now going the rounds of the press concerning a proposed railway consolidation of some importance in the South. The scheme is as follows:

Col. John D. Williamson, President of the Chattanooga, Rome & Columbus R. R., has quietly organized a new syndicate, including some of the present owners of the C., R. & C. R. R. This syndicate has obtained control of the Rome & Decatur R. R., whether by purchase or by a strong traffic arrangement is not known. The Rome R. R., from Rome to Kingston, already owned by the Williamson party, will be extended to a junction with the Marietta & North Georgia R. R. near Canton. The Rome & Decatur will soon be completed to Decatur, and by the new arrangement a through line will be perfected from Decatur via Gadsden, Rome and Canton to Atlanta, where it will have close traffic arrangements with the Seaboard Air Line to Portsmouth, Va., and on the northwest of Knoxville with an early extension to the Ohio River. It is thought that this syndicate, operating from the new line from Decatur to Canton, has some stronger hold than a mere traffic agreement with the two other systems, and that it promises a consolidation of the Seaboard Air Line, the Marietta & North Georgia road, and the Decatur & Canton line.

Projects and Surveys.

Metropolitan Western.—A bill has been introduced into the Virginia Legislature incorporating this company to build a railway from a point on the Potomac River in Fairfax Co. to a point on the same stream in Prince William Co. Among the incorporators are: J. D. Moncure, M. J. Laughlin, L. D. Whitaker, and D. S Mackall.

Ronceverte, Louisburg & Coal Knob.—Chartered in West Virginia to build a railway from Ronceverte to Grafton, W. Va. The incorporators are: E. T. Haines, of New York City; J. A. Handley, J. A. Preston, H. T. Bell and L. S. Williams, of Louisburg, W. Va.

Louisville & Hodgdenville.—A railway company by this name has been incorporated in Kentucky with a capital stock of $30,000. The incorporators are: J. N. Hays, J. W. Croan, J. W. Ridgeway, Gilbert Griffin, F. M. Hardy, W. N. Hays, O. T. Patty, and Jacob Hubbard.

Kentucky.—Bills have been introduced into the Kentucky Legislature, incorporating the Big Hill & Winchester and the Anderson Hill Incline Plane & Railway companies.

Appalachian Belt.—A railway company by this name has been chartered in Virginia.

Palatka & Lake Shore.—It is stated that surveys will soon begin on this Florida railway. The road is projected to run from Palatka to Kissimmee. John H. Darve, of Palatka, Fla., is interested.

Mobile, Jackson & Kansas City.—The city of Mobile, Ala., has completed the $250,000 subscription asked by this company.

NORTHWEST.—Existing Roads.

Indiana & Illinois Southern.—This road running from Switz City, Ind., to Effingham, Ill., has been sold to W. H. Allen for $100,000. The road will remain under the old management. It is the purpose of the company to extend the line southwest to St. Louis and northeast to Indianapolis, Ind., as soon as practicable. This will make necessary the construction of about 200 miles of road, passing through some of the best agricultural lands in Indiana and Illinois.

Projects and Surveys.

Nebraska Central.—Amended articles of incorporation of this company have been filed in the office of the secretary of state at Lincoln. The capital stock is increased from $1,000,000 to $4,500,000. The line runs through Cedar, Wayne, Dixon, Knox, Cuming, Burt, Dodge, Washington, and Douglas to Omaha. The charter provides for the constructing and maintenance of a railway bridge over the Missouri River at the city of Omaha.

Neillsville & Northeastern.—A project is on foot to build a railway by this name to run from Neillsville, Wis., to Marshfield, Wis. R. J. McBride, of Neillsville, is interested.

SOUTHWEST.—Existing Roads.

Missouri, Kansas & Texas.—A press dispatch states that work has been commenced upon the extension of this road from Boggy Tank, Tex., to Sealy, Tex., a distance of 24 miles. It is also stated that the company has purchased the Texas & Western Narrow Gauge R. R., running from Sealy to Houston, Tex., and will soon open a line into Houston.

Cleveland, St. Louis & Kansas City.—At a meeting of the stockholders, recently held, it was voted to increase the stock of this company from $1,500,000 to $12,000,000. Of this amount, $2,500,000 is to be preferred. It is stated that the road will soon be completed.

St. Louis, Arkansas & Texas.—It is reported that this road will be extended to Dallas, Tex., from a point between Plano and Carrolton, as soon as the right of way can be obtained and other necessary arrangements made.

Projects and Surveys.

Colorado, Kansas & Gulf.—Chartered in Kansas to build a railway from Denver, Colo., to a point on the Gulf Coast, in Texas. Among the incorporators are: B. J. Smith, W. D. Weller, S. M. Judson, V. J. Miller, S. E. Sisson, and others.

Kansas.—A press dispatch from Topeka, Kan., speaks as follows concerning the probable railway construction in 1890 in this State:

Kansas, which took the lead in railroad construction in 1888, has done comparatively little in that line since. It is probable that several short lines of road will be built during 1890. Among the number are the Seneca & Nemaha Valley R. R., the projectors of which are now investigating the most favorable route from Table Rock, Neb., to Havensville, Kan., and arranging for preliminary surveys. The Topeka, Westmoreland & Marysville road will also be built during the Spring and Summer of 1890. Topeka has voted $30,000 in bonds in aid of the enterprise. Bonds for this road have been voted in all but two townships between Topeka and Marysville, and it is said that

the money to build the line has been pledged by Eastern capitalists.

Decatur.—Chartered in Texas to build a railway from Bridgeport to Decatur, Tex., a distance of 10 miles. The incorporators are S. W. Lea, of Chicago, Ill., J. T. Hockley, of St. Louis, Mo., and W. C. Connor, of Dallas, Tex.

Hamilton, Waco, Trinity & Sabine.—A press dispatch from Waco, Tex., states that a company has been formed to build a railway by this name. The lumbermen of the territory through which it is projected to run have agreed to take $150,000 of stock and to furnish right of way for 150 miles and the necessary grounds for stations. The city of Waco consents to take an equal amount of stock and to give the right of way for 50 miles on each side of the city and land for yards and station. The road will run through Alexandria, Ogden, Trinity, Groesbeck, Waco, Crawford, Gatesville and Hamilton.

Kansas City, Nevada & Fort Smith.—It is thought that the location of this line will be completed in about one month, and that active construction will commence soon. The road is to run from Kansas City to Monette, Mo., 160 miles. F. W. Bond, of Kansas City, Mo., is Chief Engineer.

ROCKY MT. AND PACIFIC.—Existing Roads.

Southern Pacific.—The annual report of this company for the last fiscal year shows the following results from operations:

Gross earnings	$16,146,199
Operating expenses	14,801,894
Net earnings	1,344,305

Fairhaven & Southern.—About 25 miles of the line from Fairhaven, Wash., to the International boundary have been graded, and tracklaying will begin as soon as the rails can be obtained. Between the International boundary and New Westminister, B. C. the line is graded.

Oregon Ry. & Navigation Co.—Preparations are being made to begin work on the branch from La Grande to Elgin, Ore. Antonelle & Doe, of San Francisco, Cal., are the constructors.

Projects and Surveys.

Carriboo.—A bill is before the British Columbia Legislature incorporating this company to build a railway from a point on the Canadian Pacific R. R., near Kamloops, northwest to Bakerville.

Washington.—A press dispatch states that a company has been incorporated by responsible parties to build a railway from Ballard, a suburb of Seattle, Wash., to the coal mines about ten miles north of Seattle.

North.—Engineers are reported making surveys for this road, which is to run from Prescott, Arizona, to a connection with the Atlantic & Pacific R. R.

FOREIGN.

Colombia Railway & Navigation Co.—H. C. Parsons, of 816 Fifteenth Street, Washington, D. C., writes as follows:

Our present purpose is simply to send an engineering party to make a barometric survey of the Cordilleras Mountains, at the headwaters of the Magdalena River, embracing a width of about 150 miles. This region has never been explored, and if it is found that the mountains can be crossed, it will then be time to definitely arrange a plan for the construction of the line and to ask aid from the governments. We have already received much encouragement from the South American Republics and have every reason to expect concessions, etc. A fund to meet the expenses of this survey and to be the basis of the enterprise has been started and will be limited to $200,000. It has been placed in small allotments in the several sections of the country, so as to awaken a popular interest in the matter. The surveying party expects to start for South America in about 6 or 8 weeks.

Mexico.—The *Mexican Financier* says: "The Executive has approved a contract made between the Department of Public Works and Mr. J. Antonio Pliego Perez, Manager of the Ixtacalco R. R., for the building of a railway and its corresponding telegraph or telephone line, which, starting from the Garita "Porfiro Diaz," and passing through the calzadas of Belem to Chapultepec, Veronica and Consulado, shall terminate at the Garita of "Arteaga," having power to perfect the service of his circuit lines by crossing the Paseo de la Reforma at points approved by the Department. The same gentleman is empowered by another concession, to build a similar line between the Puente del Molino and the town of Mexicalcingo, with power to prolong the line to the town of Ixtapalapa."

Delagoa Bay.—In a ministerial order recently published the Portuguese government authorizes the working of the last section of Delagoa Bay Ry., from Incomati to the Transvaal frontier. By this decree the whole line is now placed under the administration of the state.

Costa Rica.—The government has granted a concession to an English company to build a railway from San José to Espurda, a distance of 36 miles.

Mexican National.—A press dispatch from the City of Mexico says: The commission appointed by the Government to examine this railway and its methods of doing business has returned and, after making further inquiry, will present its report, which is likely to be an important one.

Work on the line across the Isthmus of Tehuantepec is making good progress, with over 2,000 men employed. Up to date 47 kilometers are completed from Coatzacoalcos on the Gulf and 80 kilometers on the Salina Cruz or Pacific end. The great provisional bridge, 1,250 feet long, over the Tehuantepec River is finished. It will eventually be replaced by an iron structure.

RAPID TRANSIT.

Cable Railways.—A company has been organized with a capital stock of $1,000,000 to put in the Vogel & Whelan cable system at Detroit, Mich. Col. James M. Clark is interested. The conduit will be only 10 ins. deep and 6 ins. wide. The cables will last, it is said, from 2½ to 3 years. The New York office is at 45 Broadway. President, Calvin Goddard: Secretary, H. B. Harnford.

The Broadway Line, St. Louis, Mo., is to be converted to a cable system. Work is to be commenced by April and completed in two years. The line is 7½ miles long and is owned by the syndicate headed by Mr. Holmes, of Chicago.

Electric Railways.—The Council Committee at Rochester, N. Y., appointed to confer with the Rochester City & Brighton Ry. Co. regarding the substitution of electric for horse traction, has recommended that permission be given the company to adopt the overhead system. The storage battery system may be adopted later if desired. The current is not to exceed 500 volts.

At Philadelphia, Pa., a storage battery car owned by the McLoughlin Electric Co. is being tried on the German town branch of the People's line.

The Newport Electric Car Co., of Newport, Ky., has been incorporated by H. M. Healey, H. Buchanan and A. J. Paulin. Capital stock, $100,000.

An electric railway between Urbana and Champaign, Ill., is projected.

At Keokuk, Ia., the Keokuk Electric Street Ry. & Power Co. has been incorporated by M. H. King, Thos. Mitchell and A. J. Chapman. Capital stock, $200,000. The ordinance requires 6 miles of line to be in operation by November.

The company building the line between Tacoma and Puyallup, has applied for a franchise for an electric line in Ellensburg, Wash.

At Mt. Vernon, Wash., an electric railway is projected to Big Lake, where it will connect with the Fairhaven & Southern R. R. The length will be 4 miles.

Street Railways.—The Fiftieth Street, Astoria Ferry & Central Park Ry Co. has been organized to build a line about 7¾ miles long in New York City. Capital stock, $500,000. Incorporators, F. A. Bartlett, R. A. Greacen, J. F. Harrison, H. M. Ruggles, C. E. James, John W. Mersereau and F. C. Pemberton.

At Buffalo, N. Y., the franchise for a street railway was sold at auction recently to the Cross Town Ry. Co., at 11¾ per cent. of the gross receipts. The company was recently organized at Rochester by Frederick Cook, Arthur Leitchford, F. H. Smith and others. The line may be operated by cable or electricity.

At Chattanooga, Tenn., it is proposed to build a line to Chickamauga, Ringgold and Catoosa.

The Lima Ave. & West Park St. Ry., of Lima, O., has been sold to Mr. Geo. B. Kerper, of Cincinnati, at $30,000. Mr. Kerper already owns the Main St. and Tiffin Ave. lines. The line is 3 miles long.

At Oskaloosa, Ia., the contractors have filed a bond for $3,000 to have 3½ miles of line completed by August.

The Cross Town Rapid Transit Ry. Co., of Houston, Tex., has been sold out by President N. Lewis to Henry Elmendorf, who represents the New England owners of the Lakeview property. The line will be extended.

Elevated Railways.—The contract for 3½ miles of elevated railway in Chicago was awarded, Feb. 12, to Carnegie, Phipps & Co., of Pittsburg, Pa., at about $1,000,000. The council has passed the ordinance for the West Side Rapid Transit Co.'s elevated railway.

HIGHWAYS.

Washington.—The County Commissioners at Puyallup have granted the sum of $700 for the repairing and extension of the county road known as South Ash St. This is in addition to the $1,000 subscribed by the adjoining property owners. There is to be a new road from Sumner to Puyallup.

New Jersey.—A macadamized road between Asbury Park and Belmar is at last assured. The old turnpike has been abandoned by its owners and turned over to the Neptune Township authorities. The surveyors of the highways met and laid out a new road, which will be 60 ft. wide from Asbury Park to Avon, and from the latter place to Belmar it will be 100 ft. in width.

Maryland.—At a special meeting held by the Mayor and Council of Westminster, the question of taking control of the portion of the Baltimore and Reistertown turnpike which constitutes the main street was discussed, and it was agreed to submit a proposition to the turnpike company to take the roadbed in Westminster in consideration of $300 annually to be paid by the company. The proposition was accepted by the turnpike company. A bill has been prepared for submission to the Legislature requiring the county commissioners to pay back annually $500 of the $1,600 road tax levied upon the town, for which very little is received in return. An extra levy is required to keep the five or six miles of road in the town in order.

Wisconsin.—At the recent farmers' convention, at Madison, President Mitchell advised the farmers to cease their war on railways and to turn their attention to securing good highways.

California.—The county of Mariposa proposes to build two roads, one from Bear Valley to Coulterville, 12½ miles long, with one bridge of at least 130 ft. span, and one road from Mariposa to Yosemite Valley, 38 miles long, with one bridge at least 160 ft. long. Bids are invited. For information apply to Maurice Newman, County Clerk Mariposa, Cal.

Ohio.—The records of the Legislature indicate that the lawmakers are awaking to the need of better roads. Recently four bills for improving the roads were introduced in the House on one day. None of them were general in their nature, however. They will affect only certain counties or parts of counties if passed. The bill for improving all roads in Cuyahoga Co. outside of municipalities provides for the election of township supervisors, or in townships where there is more than one precinct a supervisor for each precinct. It gives the supervisor power to make such permanent improvements in the way of graveling, grading, and the like as the tax levy will permit, and provides that all work exceeding $50 in cost shall be let by contract. The other bills affect Coshocton, Belmont and Crawford counties respectively, and provide for general road improvement and for the construction of free turnpikes. In general these bills will improve the country roads of the counties to which they apply, and are, therefore, to be commended. It is to be regretted, however, that some general law for the whole State is not proposed. A law that would organize an intelligent force of road-makers in every county with a good county supervisor at its head is what is needed. To this should also be added the provision that all road taxes should be paid in cash.—*Cleveland Leader.*

WATER-WORKS.

NEW ENGLAND.

Cape Elizabeth, Me.—Arrangements will probably be made with the Portland Water Co. to supply the township with water, if favorable action is taken upon the subject of water supply at the March election.

Dover, N. H.—The city is discussing the advisability of purchasing the company's plant.

Boston, Mass.—Mayor Thomas N. Hart has forwarded the following communication to the Common Council, stating that the subject "has the approval of the Fire Commissioners, and is amply deserving of early and favorable action:"

The Boston Water Board respectfully recommends the passage by the City Council of an order authorizing a loan of $100,000, wherewith this board may extend the high-service pipes in the low-service districts of the city, in order to afford sufficient pressure to supply sprinklers and stand-pipes in the business section, as a precaution against fire, in accordance with the petition of Brown, Durrell & Co., and other citizens. Respectfully submitted,

BOSTON WATER BOARD,
By Robert Grant, Chairman.

Middleboro, Mass.—The report of the Water Commissioners for 1889 gives the number of gallons pumped per pound of coal as 145.26 for total coal used; also the number of gallons raised 100 ft. high per pound of coal, for total coal used, 290.52.

Woonsocket, R. I.—The Common Council has passed an ordinance appropriating $18,000 for extensions and improvements.

South Norwalk, Conn.—The following bids have been received for the East Norwalk extension to the South Norwalk Water-Works:

Contractors.	Pipe laying. Per foot. 10 in.	8 in.	6 in.	4 in.	Removing old pipe.	Plank, per M.	Lump bid.	Ward joint per ft.	Totals.
Adam Miller, Saratoga, N. Y.	80 cts.	30 cts.	26 cts.	23 cts.	.....	.....	.....	.....	$3,656.60
John O. Merritt, Portchester, N. Y.	55 "	43 "	33 "	23 "	30 cts.	$30	.....	.....	4,055.24
Daniel Murray, Portchester, N. Y.	46 "	31 "	29 "	24 "	36 "	20	.....	.....	3,572.56
Francis Leonard, Norwalk, Conn.	45 "	25 "	23 "	20 "	50 "	40	.....	.....	3,036.80
Charles Chapman, Westport, Conn.	44 "	35 "	32 "	24 "	.....	18	$4,332.76	$3.20	4,332.76 / 4,232.56
Frederick M. Pierce, So. Norwalk, Conn.	39 "	33 "	27 "	24 "	25 cts.	36	.....	50	3,398.10

The contract was awarded to Francis Leonard. Work is to be completed by May 15. William B. Rider, of South Norwalk, is the Engineer in charge.

MIDDLE.

Baldwinsville, N. Y.—The new works were satisfactorily tested on Jan. 27, and have been accepted by the town.

Cohoes, N. Y.—A bill has been introduced in the Senate by Senator Chase which authorizes the Common Council to issue $20,000 of bonds for improving the works.

New York, N. Y.—The contract for constructing the dam for Reservoir M, on Titicus River, near Purdy's Station, has been awarded to Washburn, Shaler & Washburn, the lowest bidders, at $933,065.

Newark, N. J.—The Executive Committee has recommended that a main be laid in Hunterdon St. from 17th Ave. to 18th Ave., and to Waverly Place. Proposals for furnishing 30,000 ft. of 6 in. cast-iron pipe have been received as follows: R. D. Wood & Co., Philadelphia, $29.75 per ton; Mellert Foundry & Machine Co., Reading, Pa., $29.12 per ton; Warren Foundry & Machine Co., Phillipsburg, N. J., $28.70 per ton; M. J. Drummond, New York, $28.70 per ton; McNeil Pipe & Foundry Co., Burlington, N. J., $29 per ton. The contract was awarded to the Warren Foundry & Machine Co.

Plainfield, N. J.—Water has been reached in the test wells driven near the Netherwood Depot.

Camden, N. J.—A bill has been introduced in the Legislature authorizing the city to acquire additional lands and property, and water source and water rights, for the improvement and extension of the water supply, either in the city or within 20 miles thereof. Reservoirs, pumping stations and other buildings can be erected and the lands can be acquired in fee simple. Power is given to the Chief Engineer of the Water Department to treat with the owners to secure such lands. This bill will also apply to all other cities in the State. The bill also gives the City of Camden power to issue bonds to the amount of $1,000,000 for this purpose.

Annville, Pa.—Preliminary surveys and estimates have been made for a system of works by Engineers Fehr & Butler, of Easton, Pa., of whom full information can be obtained.

Rochester, Pa—The Valley Water Co. has been incorporated with a capital stock of $50,000. The directors are W. S. Shallenberger, John Conway, of Rochester; John R. Eakin, Richard R. Quay, of Beaver; H. W. Hartman, of Beaver Falls.

Royers Ford and Spring City, Pa.—J. A. Buckwalter, President of the Home Water Co., of Royers Ford, has sent us the following:

The new works will be completed about March 1; work was begun in April, 1889. The supply will be pumped from artesian wells to a stand-pipe, 20 ft. in diameter by 80 ft. high; capacity, 184,000 galls. There will be 6 miles of cast-iron mains, and 30 hydrants. Estimated cost, $40,000. The officers are: J. A. Buckwalter, President; U. S. G. Finkbiner, Secretary; S. B. Latshaw, Treasurer. Isaac S. Cassin, of Philadelphia, is the Engineer. Contractors: Pumping machinery and boilers, Gordon Steam Pump Co., of Hamilton, O.; Pipe, Mellert Foundry & Machine Co., of Reading Pa.; Specials, Union Hydraulic Works, Germantown, Pa.; Stand-pipe, Conley Boiler Co., Philadelphia.

Bridgeport, Pa.—Works are being constructed.

Cumberland, Md.—A filter plant will probably be put in or a new source of supply adopted. J. W. Avirett, Editor of the daily *Times*, can furnish information. City Attorney R. W. McMichael has been directed to prepare two bills to be submitted to the Legislature: one to refund $70,000 of the city water bonds, maturing in 1890, at a sum not exceeding 4 per cent.; the other to refund $30,000 of the floating debt of the city bonds, bearing interest at a rate not exceeding 4 per cent.

SOUTHERN.

Norfolk, Va.—In the Superintendent's report for the year ending June 30, 1889, an account is given of the damage done to the mains and reservoirs by the storms of 1889. The average daily per capita consumption for the year, with an estimated population of 27,000, was 117 galls.

Gordonsville, Va.—J. J. Nicholson & Son, of Baltimore, Md., are offering 2,000 6 per cent. bonds for sale.

Tarboro, N. C.—It is reported that the Tarboro Cotton Factory is putting in a system of works.

Hendersonville, N. C.—J. J. Nicholson & Son, of Baltimore, Md., are offering 6,000 6 per cent. bonds for sale.

Atlanta, Ga.—A vote will be taken on March 8 on the question of issuing $250,000 of bonds for improving and increasing the city's water supply.

Johns, Ala.—It is reported that two Blake pumps are being erected, and that J. E. Strong is the Engineer in charge.

Natchez, Miss.—The supply will be taken from artesian wells. Bids for sinking them will probably be wanted soon.

New Orleans, La.—The Exposition water works are to be examined and put in working order by the city.

North Knoxville, Tenn.—The contract with the Woltmann Water-Works Co., of New York, has been ratified by the City Council.

The company agrees to maintain 65 hydrants for 20 years, at an annual rental of $35 per hydrant. Work is to be commenced within 60 days and completed within 8 months. The supply will be taken from Fountain Head.

Bristol, Tenn.—The Goodson Board has decided to issue $3,500 of additional bonds to extend the Bristol-Goodson water works system.

Johnson City, Tenn.—Young & Co., of Philadelphia, Pa., have been awarded the contract for constructing the works by R. A. Johnson, of 45 Broadway, New York, to whom a franchise has been granted.

Franklin, Tenn.—Works are projected. Address P. E. Cox.

Newport, Ky.—Mayor A. S. Berry, in a recent communication to the Cincinnati (O.) Board of Public Works, offered to sell to said city the entire city's plant for $800,000; Newport to become a joint consumer with Cincinnati, paying the usual water rates.

Clay City, Ky.—It is reported that new works will soon be put in operation. Address the Kentucky Union Land Co.

NORTH CENTRAL.

Columbus, O.—According to the last annual report the excess of earnings above operating expenses and repairs has increased from $1,902 in 1876-7 to $95,329 in 1888-9.

Mansfield, O.—The annual report for the year 1888-9 contains a brief history of the works.

Carthage, O.—The City Council has decided to construct a Holly system of works. The proposed plan calls for 24 hydrants. The estimated cost is $15,000. The question of issuing the village bonds to this amount will be submitted to the voters at the regular spring election.

Fairland, Ind.—The Fairland Natural Gas, Oil, Coal & Water Co. has been incorporated. The capital stock is $10,000. The directors are: John K. Smith, John B. Harrell, John E. West, John W. Snider, James W. Parkhurst, James K. Stewart and Erastus T. Carson.

Detroit, Mich.—At a recent meeting of the City Council a resolution was offered by Commissioner Caskey, and unanimously adopted, to lay another large inlet pipe to extend at least 500 ft. further into the river than the one now in use, and to connect directly with the pump wells. Supt. Bridge was instructed to prepare an estimate of the cost of this improvement, to be submitted to a special meeting of the board as soon as he is ready to report. The estimated cost is $50,000 to $60,000. The proposed plan to construct a settling basin has been abandoned.

Iron Mountain, Mich.—Jos. H. Sandercock, Chairman of the Water Works Committee has sent us the following:

The town wishes to grant a franchise to a reliable company, as soon as possible, for works to be completed by November, 1890. The proposed plan for securing fire protection is to collect the water of Quinnesec Falls Springs, about 2¼ miles distant, and pump it to a reservoir or stand-pipe. For domestic purposes a franchise will be granted to a company; no plan has been projected.

Alton, Ill.—The new filter has been floated into position and sunk in the river opposite the works. The pipe connecting the crib with the works will be put in immediately, and the filter will then be ready for use.

Venice, Ill.—It is reported that the bridge company has made proposals for the purchase of the village works.

NORTHWESTERN.

Algona, Ia.—The following is from J. R. Jones, Mayor:

No contracts have yet been let. It is proposed to begin work early in the spring. Water will probably be pumped from wells to a stand-pipe. Drilling is now in progress. Population, 2,500.

Sioux Rapids, Ia.—The City Council has voted to build a 50,000 gall. water tank for fire protection.

Chester, Ia.—We have received the following from E. J. Sidey, City Clerk:

A. L. Strang, of Omaha, had 40 days in which to accept a franchise, which he failed to do. The works have not been built, and there is no probability that he will build them.

Fayette, Ia.—J. E. Fowells, Recorder, informs us that the question of constructing works will be decided by a vote on March 3.

Glenwood, Ia.—The following is from Seth Dean:

The well is now down about 1,300 ft., water stands in the pipe 40 ft. below the surface. It will be sunk deeper, as the prospect seems good for a flow. The council has not yet decided what will be done in the way of water-works this spring, but it is probable that some kind will be commenced after the city election is over in April.

Hawarden, Ia.—Bids will be received until Feb. 20th for constructing complete works; also for any part of the works. Specifications can be obtained from W. W. Hall or Thomas G. Betts, Committee on Water-Works.

Jefferson, Ia.—Town Recorder E. S. Young has sent us the following information:

An artesian well has been drilled to a depth of 2,020 ft., and water rises to within 15 ft. of the surface. The work has cost $6,000, procured by 10-year 5 per cent. town bonds. The intention is to issue more bonds, and put in some system of works for fire protection and domestic supply. A vote of the people will be necessary; no date for taking it has been decided upon.

Le Mars, Ia.—J. M. Dunn informs us that the new works have been completed and accepted and are giving good satisfaction.

Manchester, Ia.—C. H. Day, City Clerk, writes: "Vote carried. Committee appointed from City Council to investigate and ascertain the best system, etc. J. F. Merry, Chairman."

North Des Moines, Ia.—Mayor John MacVicar has sent us the following:

The town has compromised with the North Des Moines Water Co., allowing them to pump water from the Des Moines Water-Works Co.'s pumping station. The compromise price is $500 per mile. The original price was $1,000 per mile.

Sibley, Ia.—The following information is from M. J. Campbell:

It has been shown by the experimental well recently sunk that water can be secured from artesian wells at a depth of about 200 ft. No further steps have been taken, and probably none will be by the present official. A new Council will be elected in March.

Chatfield, Minn.—We have received the following from C. H. White:

Only 200 ft. of pipe have been laid. It has not been decided how much pipe will be laid, nor how many hydrants will be used. The pump has not been purchased. Work will probably be begun again in the Spring.

Lewiston, Minn.—The well has proved successful, a steady flow of water having been secured at a depth of 277 ft.

Baxter Springs, Kan.—H. R. Crowell has sent us the following information:

The field is now open to parties willing to construct works. The party to whom the contract was awarded failed to begin work, and forfeited all rights.

Osage City, Kan.—Major W. B. Artz sends us the following:

A franchise was let two months ago to a party to establish works. Construction is to be commenced on Feb. 27.

Girard, Kan.—The following is from James S. James:

The Montauk Construction Co., 11 Wall St., New York, has been granted the franchise, and have filed acceptance and bond. Work has not been commenced as yet. Mr. Bullock and an engineer are expected to commence operations at an early day.

Horton, Kan.—Difficulty in securing a water supply is reported as the cause for the non-establishment of works.

Blue Rapids and Belleville, Kan.—E. E. Stevens, of Beloit, Kan., informs us that works are being constructed at these places.

Marysville, Kan.—The new works were completed on Feb. 4. A 1,000,000-gall. compound duplex Worthington pumping engine raises water to a stand-pipe having a capacity of 59,000 galls. The officers of the Marysville Water Co. are: E. E. Stevens, President, of Beloit, Kan., J. S. Simmons, Secretary. Cost, $50,000.

Brookings, So. Dak.—Regarding the proposed works, W. H. Riddle sends us the following:

The new works are to be run in connection with the electric light plant. Water is pumped from wells to a tank. Cost, $6,000. They were put in operation about Feb. 1.

Buffalo Gap, So. Dak.—An artesian well is being sunk by Durst Bros.

Wymore, Neb.—City Clerk Geo. S. Humphrey informs us that they will set 51 Adam's hydrants, lay about 4½ miles of pipe, erect a 750,000-gall. pump, as well as a stand-pipe, 12 ft. internal diameter by 100 ft. high.

Hooper, Neb.—J. W. Lyman, Town Clerk, writes: "It being necessary to revise the original plans, contract will not be let until March 10."

Tekamah, Neb.—We have received the following from E. B. Atkinson, City Clerk:

The corporation voted to issue $15,000 of bonds for constructing works in July, 1889, but the bonds failed to be registered. No steps, therefore, were taken by the city to construct works, except sinking several test wells. Works will probably be established during the coming year.

SOUTHWESTERN.

Butler, Mo.—Mayor G. B. Hickman sends us the following information:

H. S. Dewey, of Jefferson City, Mo., has been granted a franchise for constructing works to be completed by July 1. No work has yet been done.

Webb City and Carterville, Mo.—Nier, Hartford & Mitchell, of Kansas City, Mo., Engineers for these works, have sent us the following:

The new works will be completed about May 1. Work was commenced Feb. 1, 1890. The contracts have been awarded as follows: Construction, E. Sutphin, St. Louis, Mo.; pumping machinery, 21,000,000 gall. engines, Hall Steam Pump Co., New York; boilers, J. Matthews, South Bend, Ind.; pipe and specials, Shickle, Harrison & Howard Iron Co., St. Louis, Mo.; hydrants, White; 90 valves, Scott. Water is pumped from Center Creek to a stand-pipe, cost $75,000; procured by 6 per cent. bonds. James O'Neil, of Webb City, is President of the company building the works, which has a 20 years' contract with the city for $60 per hydrant per year.

Beebe, Ark.—F. P. Beebe, President of the Beebe Artesian Well Co., informs us that he has contracted with Eugene Witt for sinking a well. If the well is a success, water will probably be pumped to a stand-pipe.

Denver, Col.—The Board of Aldermen has passed the ordinance recently introduced by the Denver Water Co. The company will set 1,000 new hydrants if the city renews its contract for a term of 20 years from 1891. The Citizens' Water Co. has also offered to take the 493 hydrants now in use at $25,000, and made other stipulations, equal in all respects to the proposition made by the former company.

PACIFIC.

Tacoma, Wash.—It is now reported that the city has reached an agreement with the Tacoma Light & Water Co., whereby $500,000 to $750,000 will be expended in improving and enlarging the existing plant. Green River is mentioned as a new source of supply.

Latona, Wash. (A suburb of Seattle.)—A water supply is to be furnished by a company. A large storage reservoir is to be constructed on the heights above the town, to be supplied from a large spring. Water will be conveyed by gravity through a 6 in. main from the reservoir to the town, and mains will be laid on all of the principal streets. Work will be commenced soon.

Independence, Ore.—The Independence Water & Elec-

tric Light Co. has been incorporated with a capital stock of $40,000. The incorporators are: H. Hershberg, A. J. Goodman, H. H. Jasperson, A. Nelson and J. Donsike.

Heppner, Ore.—We have received the following from A. Malloy:

Works costing from $15,000 to $20,000 will be constructed by the city. Water will be pumped from wells to a tank. Hydrants will probably be used. Population, 1,000.

Redding, Cal.—Notice has been given of the formation of the Citizens' Water Co., with a capital stock of $100,000. Clay W. Taylor, Attorney for the company, will ask for a franchise at the next meeting of the City Trustees.

San Bernardino, Cal.—F. C. Finkle, engineer for the new works, has kindly sent us the following information:

Contracts for supplies, construction, etc., have not been let. Work will be commenced about June 1, and is to be completed by Jan. 1, 1891. Water will be conveyed by gravity from artesian wells to a reservoir of 3,000,000 galls. capacity. The works will be constructed, owned and controlled by the city. Mayor, O. Newberg; City Clerk, B. B. Harris; City Treasurer, C. F. Roe. The following supplies will be required: pipe, cast and kalamein iron, 12 to 6 ins., 18 miles; hydrants, 70, double nozzle; valves, etc. The estimated cost is $160,000, procured by 6 per cent. bonds. Population, 10,000.

Provo City, Utah.—Plans for works capable of supplying a city of 25,000 inhabitants have just been completed. There will be about nine miles of mains. Estimated cost, $65,000. The distributing reservoir will hold 1,000,000 gallons. Sturges & Bryant, of Salt Lake City, are the Engineers.

Salt Lake City, Utah.—Ordinances are being passed, and assessments made, for a considerable amount of extensions.

PROJECTS.

Works are projected, or have been mentioned, in the following places: Fossil, Ore., indefinite.——Uniontown, Wash., indefinite.——San Pablo, Cal., no works proposed.——Mansfield, Tex., Sinking an artesian well; will erect windmill and tank; G. A. Graves.——Franklin, Tex., F. J. Miller.——Cameron, Tex., the Mayor.——Chicontimi, P. Q., indefinite.

CANADA.

Halifax, N. S.—The City Engineer's report for the year ending April 30, 1889, has appended to it some reports made the last part of 1889 by City Engineer Keating, on the efficiency of the city water supply. Extensions and improvements are deemed necessary, among which are the raising of Lower Chain Lake to the same level as Long Lake; also the construction on Camp Hill of a low-service distributing reservoir, capable of holding at least two or three days' supply. Meters are recommended for al "manufactories, establishments and premises where there is lavish consumption or waste of water," and it cannot otherwise be conveniently checked.

Barrie, Ont.—Engineer Willis Chipman, of Brockville, Ont., has submitted a report to the Mayor and Council on the proposed system of water-works. He recommends that the supply be taken from artesian wells and pumped to a stand-pipe, 50 ft. high by 25 ft. in diameter. The cost is estimated as follows:

Pumphouse, site, chimney, etc.	$5,000
Pumping machinery, boilers, etc	8,000
Pipe, 27,000 ft., 10 to 4 in. and 50 hydrants, and necessary valves	30,000
Stand-pipe	7,000
Engineering, etc	3,000
Eight wells, connecting-pipes, etc	4,000
Total	$57,000

ARTESIAN WELLS.

Houston, Tex.—Bids are wanted for boring an 8 or 10 in. well. Address W. E. Wood, H. & T. C. depot.

Sweet Water, Tex.—Address the Mayor for information regarding the projected well.

Boone, Ia.—Work on the well has been resumed.

IRRIGATION.

La Plata, N. M.—The Hillside Irrigation & Ditch Co. has been incorporated by John Real, James W. McDermott and M. F. Thompson.

Cerro, N. M.—About 20 miles of the Taos & Rio Colorado Irrigation Co.'s canal has been finished. Profiles and estimates and maps showing the amount of land to be covered by the company are now being prepared. The main canal will be about 35 ft. wide. The following officers have been elected: J. C. Quinn, President; Frank Phillips, Superintendent; John H. Young, General Manager and Immigration Agent.

Lane Park, Fla.—It is reported that Mr. Muir is constructing a system of water-works for irrigating purposes to cost $15,000.

Maxwell, Cal.—The Board of Directors of the Central Irrigation District has ordered the sale of $225,000 of bonds.

It has also ordered that advertisements be made for contracting for the building of 20 sections of the big ditch, aggregating about 20 miles. This is in addition to the 7 miles now contracted for to be built by the San Francisco Bridge Co. About 1,000,000 ft. of lumber will be required for use in the erection of bridges and culverts over that portion of the canal now advertised to be built.

Cheyenne, Wyo.—The Interstate Canal & Irrigation Co. is preparing to commence work upon a large canal. The supply will be taken from the Platte River, near the Nebraska and Wyoming line. Estimated cost, $250,000. K. A. Johnston, City Engineer, has resigned his position to take charge of the operations of the company. Work is to be commenced at once.

SEWERAGE AND MUNICIPAL.

Street Work.—*Fall River, Mass.*—An appropriation of $50,000 has been made for street work.

Brooklyn, N. Y.—Graham Ave. will probably be paved with granite blocks from Grand St. to Van Cott Ave., about one-half mile. The Council has passed ordinances for a considerable amount of flagging, curbing and paving.

Barboursville, Ky.—It is proposed to issue bonds for street improvement. For particulars address the Mayor.

Cleveland, O.—The Board of Public Improvements has endorsed the bill for paving more than 60 streets. It provides that the city shall issue bonds, running not to exceed 8 years, for the paving of streets, these bonds to be paid by the gradual collection of paving taxes from the property owners along the street. The name of the street to be paved must be inserted in each bond. Fire-clay brick paving is to be laid on Scranton Ave.

Columbus, O.—The city engineer has been directed to prepare plans, specifications and estimates for the improvement of a number of streets.

Detroit, Mich.—About 5,000,000 paving bricks have been purchased in Decatur, Ill., for paving about 40 blocks. The brick will cost $13 to $15 per 1,000, delivered.

Chicago, Ill.—The property owners on Lake Ave., between Fifty-first and Fifty-seventh sts., have decided to ask that the street be paved with fire-brick instead of cedar blocks. An ordinance has already been passed by the City Council for a cedar-block pavement, but the assessment has not yet been confirmed. The avenue is traveled almost exclusively by heavy teams, and many of the property owners objected to a cedar-block pavement, believing it will not stand the traffic. It is said a fire-brick pavement could be put down as cheaply as cedar blocks.

Matoon, Ill.—The question of paving the principal streets is being discussed, and the Council is given power to take action in the matter.

Sewers.—*Boston, Mass.*—The city has made an appropriation of $50,000 for rebuilding Dorchester Brook sewer.

Providence, R. I.—An appropriation of $50,000 has been made for sewers.

Jamestown, N. Y.—A bill has been prepared for the Legislature to constitute the citizens' committee (recently appointed by Mayor Price, to report a system of sewers) a commission, and to allow $5,000 to be raised by taxation for defraying the expenses of such commission.

Troy, N. Y.—The Public Improvement Commission has been debating as to the merits of tile and brick sewers.

Jersey City, N. J.—The city authorities will take measures to have the defective sewerage of the third district promptly attended to.

Chattanooga, Tenn.—The $50,000 sewer bonds have been awarded to the Chattanooga National Bank at $57,705. The other bidders were as follows: N. W. Harris, New York, $55,608; Coffey & Stanton, New York, $53,125; Adams & Blodgett, Boston, $55,002.50; Seasongood & Meyer, Cincinnati, $53,724.75; A. L. Sputzer & Co., Boston, $53,537; N. E. Barker, Chattanooga, $56,093.50; S. G. Montague, $55,527.

Atlanta, Ga.—The Council has ordered an election to be held March 8 on the proposed issue of $100,000 for sewers.

Florence, Ala.—The city is advertising $100,000 in bonds for sewerage and street improvements.

Canton, O.—It is proposed to issue $91,000 in bonds for storm-water sewers.

Columbus, O.—Bonds for $300,000 are to be issued for the construction of a main trunk intercepting sewer.

Great Falls, Mont.—The city council has accepted the plans of G. W. Miller, who has been connected with the sewerage systems of St. Paul and Helena. They will order the construction of a main sewer on Third St., which with the laterals, will drain about 800 acres.

Halifax, N. S.—The Board of Health has resolved to apply to the Legislature for authority to borrow $400,000 to construct additional sewers, and for authority to demolish all the uninhabitable houses which owners neglect to keep in suitable repair and sanitary condition.

Brantford, Ont.—A report on the proposed system of sewerage and sewage disposal has been made by Mr. Willis Chipman, M. Am. Soc. C. E. The "separate" system of sewerage is recommended, with a sewage farm of sufficient area to dispose of the sewage from a population of 5,000. Precipitation works will not be necessary for some years. Pumping stations, the plant at which could be operated by water power, will be required. The estimate of cost is as follows: Main sewer, $33,000; sewage farm, $23,000; filter beds (for 25,000 population), $40,000; precipitation works (for 25,000 population), $20,000; two pumping stations, $9,000.

ELECTRICAL.

Electric Lighting.—At Rockville, Conn., the Westinghouse Electric Light Co. has presented a proposal to the Board of Aldermen to light the streets with their system at the rate of $74.50 a year, for lights of 2,000 c p., on a five-years' contract. The local gas company has a Thomson-Houston plant in operation, but the city has made no contract yet, as the company asked considerably more. The local company will be given the preference if it will light the city at a reasonable rate.

The Holyoke Water Power Co., of Holyoke, Mass., will probably delay the building of the $100,000 electric light station till the matter of causing electric light companies to place their wires underground is definitely settled by the Legislature. In case the matter is settled against the companies, the local company will give up all idea of making any improvements, as it cannot go to the expense of burying the wires, which in itself is a costly thing, and make improvements in the station at the same time.

At Brooklyn, N. Y., the Aldermen have authorized contracts to be made with the Municipal and the Citizens' electric light companies and the Williamsburg, Citizens', Nassau, People's, and Metropolitan gas companies for lighting the streets. The electric companies will get $182.50 per lamp per year and the gas companies $19.80.

The Consolidated Electric Light & Gas Co., of Westchester county, has been incorporated by Chas. P. Ludwig, of Brooklyn; Harold S. James and Arthur B. Elbecks, of New York City, and others. The operations of the company will be carried on in the towns of Rye, Mamaroneck, New Rochelle, Harrison and Scarsdale.

At Nashville, Tenn., the Capital Electric Co. has purchased the plant and franchises of the Nashville Light & Power Co., and will increase the plant. It is proposed to erect a building 180 × 100 ft., and boiler house 50 × 120 ft., and equip it with two 1,500 H. P. Corliss engines, and about 24 dynamos. Also generators and motors, increasing the capacity of the combined plants from 200 arc to 600 arc lights and 3,000 incandescent to 6,000.

The Winston Electric Light & Railway Co. has been organized at Winston, N. C., by the purchasers of the plant. President, F. J. Sprague; Secretary, J. H. McClement.

At Yorkville, S. C., a company is to be organized to put in a Westinghouse plant.

At Darien, Ga., an electric and gas lighting franchise has been granted to Abbott Thomas and T. S. Wylly, Jr.

The Butte Electric Light Co. has been incorporated at Butte, Mont., by W. A. Clark, P. A. Largey, and H. A. d'Acheul. Capital stock, $100,000.

Thomas and Gorman, of Houston, Tex., want an incandescent light plant with a capacity of 600 lights of 16 c. p.

The Cleburne Electric Light & Gas Co. has been incorporated by Max Elser, of Fort Worth, and W. H. Gaston, of Dallas, Tex. Capital stock, $20,000.

The Merchants' Terminal Bridge & Ry. Co., of East St. Louis, Ill., will probably establish an electric light and power plant.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—*Bothwell, Ont.*—At a meeting of the committee of Middlesex, Kent and Elgin, Ont., held recently, it was decided to call for tenders for an iron and stone bridge at this place. The structure will have a span of 220 ft. and will cost about $25,000.

Montreal, P. Q.—The bridge over the St. Lawrence River at Coteau Landing for the Canada Atlantic Ry. is now practically completed. There are 17 fixed spans; 1 of 139 ft.; 2 of 175 ft.; 10 of 217 ft., and 4 of 223 ft., with a draw of 355 ft. The structure is of steel with a total length of 1¾ miles.

Boston, Mass.—The Mayor has been authorized to negotiate with the Old Colony R. R. Co., concerning the widening of the Savin Hill avenue bridge over the tracks of that corporation, and the sum of $50,000 has been appropriated to pay the city's portion of the expenses.

Wilmington, Del.—Sealed proposals will be received until March 6 for the construction of three wooden bridges across the cut now being made from Chincoteague Bay to Indian River Bay. Address Wm. F. Smith, U. S. Agent, Wilmington, Del.

Howard Co., Md.—A bill has passed the State Senate authorizing the commissioners of Howard Co. to issue bonds to rebuild bridges destroyed by the recent floods.

Washington, D. C.—A bill has been introduced into Congress providing for the construction of a bridge of iron or stone over the Eastern branch at Benning's road, in the District of Columbia.

McKeesport, Pa.—The formation of a company to build a bridge across the Youghiogheny River from McKeesport to Lynch & Robinson's Coal Works is being talked of. A considerable amount of money has already been subscribed.

Tiffin, O.—The County Commissioners have contracted with the Massillon Bridge Co. for two bridges to cost $6,106.

Detroit, Mich.—The bill authorizing the construction of a bridge over the Detroit River at this place has been reported adversely by the Senate Committee.

Salem, Va.—The Salem Development Co. desires to communicate with iron bridge builders.

Ceredo, W. Va.—W. W. Coe, of Roanoke, Va., Chief Engineer of the Norfolk & Western R. R., will receive bids until Feb. 26 for the foundations and masonry of a bridge across the Ohio River near this place. The work will comprise about 12,000 cu. yds. of masonry in five piers and one abutment.

Wheeling, W. Va.—An election will probably be held April 27 to vote on an issue of $75,000 of bonds for the building of a bridge across the creek at Main Street. Address F. P. Jepson, Wheeling, W. Va.

Greenville, S. C.—The contract for building two bridges over the Reedy River, of 51 ft. and 120 ft. span, respectively, has been let to Grundy Bros., of Greenville.

Atlanta, Ga.—The following bids were received for constructing the bridge across the Chattahoochee River: Missouri Valley Bridge Co., Leavenworth, Kan., $13,400; Berlin Bridge Co , East Berlin, Ct., $15,980; E. E. Maher, Atlanta, Ga., $19,035; Mt. Vernon Bridge Co., Mt. Vernon, O., for the iron work only, $5,900; Massillon Bridge Co., Massillon, O., $13,985 and $14,285; King Iron Bridge Co., Cleveland, O., $14,725; Groton Bridge & Mfg. Co., Groton, N. Y., $14,000; Columbus Bridge Co., Columbus, O., $14,325; Youngstown Bridge Co., Youngstown, O., $14,990; Atlanta Bridge & Axle Co., $13,442; Pittsburg Bridge Co., $15,195; and Geo. H. Crafts, Atlanta, Ga., $13,812. The contract has been awarded to the Missouri Valley Bridge Co.

Couchville, Tenn.—The bridge mentioned in our last issue as to be built at this place will span Stone River. Address Jos. Engles, 1 and 2 Colonnade Building, Nashville, Tenn.

Louisville, Ky.—The contracts have been let for the Reservoir Ave. bridge previously mentioned.

Quincy, Ill.—A press dispatch from Quincy, Ill., says: There is a movement on foot to throw a pontoon bridge across the Mississippi River at this place, and a petition for a license to incorporate a stock company to carry out the project has been filed with the Secretary of State. The incorporators are Col. S. M. Stewart, J. N. Sprigg and ex-Congressman Anderson. It is proposed to place the bridge at the lower limits of the city, making connection with Goose Island on the west side. The company will organize with a capital of $50,000.

Duluth, Minn.—The Eastern, Duluth & Winnipeg, and the Northern Pacific railways are said to be considering plans for a bridge from this city to West Superior, across St. Louis Bay. The present bridge is unable to accommodate the traffic.

Minneapolis, Minn.—Bids will soon be advertised for for the construction of a bridge across Minnehaha Creek on the extension of Lake St.

Nebraska City, Neb.—Preliminary surveys and soundings are being made for a bridge across the Missouri River at this place.

Keytesville, Mo.—John A. Lee, Clerk, Chariton County Court, will receive proposals for the construction of two bridges located as follows: At Forest Green, Mo., over the East Fork of the Chariton River, span 107 ft.; at Keytesville, Mo., over Mussel Creek, span 112 ft. The materials of each bridge are to be of either wood, iron, or wire cable, as the court may decide on the day of the letting.

Farley, Mo.—The people of Platte Co. have advertised for a bridge across the Platte River at Farley, Mo.

Concho Co. Tex.—G. H. Garland, County Judge, will receive bids for a bridge across Concho River.

Seattle, Wash.—City Engineers Scurry & Owens have completed plans for the new Weller St. bridge. It will be of wood, 1,200 ft. long, and will reach from South Fifth St. to South Ninth St. It will be 36 ft. wide and 90 ft. high at the highest point.

Los Lunas, N. M.—The Chicago Bridge Co. has the contract for the bridge across the Rio Grande at this place.

Proposed.—Bridges are proposed at Columbus, O., Brunswick, Ga., Knoxville, Tenn., Beattyville, Ky., Lyons, Ia., Pine Bluff, Ark., and Dennison, Tex.

Tunnels.—***Chicago, Ill.***—The contract for the tunnel under the river from Market St. to Clinton St., has been let to Fitzsimmons & Connel for $750,000. The work is to be completed by Feb. 1, 1892.

CONTRACTING.

Creosoted Timber.—The following proposals for 27,096 ft. B. M. of creosoted yellow pine or spruce timber have been received by the Dock Commissioners, New York City.: Carolina Oil & Creosote Co., Wilmington, N. C. (Lamb & Bell, agents), $39 per 1,000 ft. B. M.; Creosote Oil & Lumber Co., Fernandina, Fla., $40; Lehigh Valley Creosoting Co., Perth Amboy, N. J., $50 or $65 for Georgia yellow pine in 20 or 60 days, $50 for North Carolina yellow pine in 40 days; Koppinger & Russell, New York, $52.50.

Public Buildings.—At Adairsville, Ga., a court house and city hall building is to be erected.—At Sioux City, Ia., a government building for post-office, etc., is projected, to cost $700,000.—At Red Oak, Ia., the contract for the court house will be let Feb. 25.

Jail.—At Duluth, Minn., the County Commissioners have received the following bids for 32 new jail cells: Van Dorn Iron Works, Cleveland, O., $15,750 and $15,000; Lane Bros. Bridge & Construction Co., Newark, O., $29,350; Herzog Mfg. Co., Minneapolis, $22,063.94; Pauly Jail Building & Mfg. Co., Reynolds, Ill., $30,890, $30,240, $29,690 and $28,890; Diebold Safe & Lock Co., $17,531; Globe Iron Works, Chicago, $17,549; Clyde Iron Works, Duluth, $21,092.46; Champion Iron Co., Kenton, O., $23,479, $22,500, $22,100, $21,250, $19,770, $18,500, $18,100.

Dam.—The following table gives the prices of the proposals received Feb. 5 by the Aqueduct Commissioners, New York City (as noted last week), for an earth and masonry dam, with gate-house and other appurtenances, for Reservoir M. The dam will be located on Titicus River, near Purdy's Station, North Salem, Westchester Co., N. Y. The dam will be 100 ft. high, 1,200 ft. long, and will impound 6,000,000 galls. of water. The engineer's estimate was $1,151,195. The contract has been awarded to Washburn, Shaler & Washburn. The items of the work are as follows:

(*a*) Soil excavated and placed in spoil bank.
(*aa*) Soil taken from spoil banks, etc., and placed.
(*b*) Sodding.
(*c*) Earth excavation and disposal in embankments, etc.
(*cc*) Earth or soil hauled, each 100 ft. outside of specified limits.
(*d*) Rock excavation.
(*e*) Permanent timber work, placed and fastened.
(*ee*) Permanent timber work, tongued and grooved, placed and fastened.
(*f*) Portland cement.
(*g*) Concrete masonry, 5 broken stone to 1 cement.
(*gg*) Concrete masonry, 3 broken stone to 1 cement.
(*h*) Brick masonry.
(*hh*) Brick masonry, in asphaltum mortar.
(*i*) Rubble stone masonry, laid in mortar.
(*ii*) Dry rubble stone masonry and paving, laid without mortar.
(*j*) Riprap. (*k*) Broken stone.
(*l*) Block stone masonry, dry or in mortar.
(*m*) Granite dimension stone masonry.
(*mm*) Facing stone masonry, laid.
(*n*) Face work for rubble stone masonry.
(*n n*) Fine hammered (6-cut) face dressing.
(*n n n*) Rough pointed face dressing.
(*o*) Masonry, of all kinds; additional for using American cement mortar, 1 to 1.
(*p*) Masonry, of all kinds, additional for using Portland cement mortar, 1 to 1, instead of American cement mortar.
(*p p*) Ditto; Portland cement mortar, 2 sand to 1 cement.
(*p p p*) Ditto; Portland cement mortar, 3 sand to 1 cement.
(*q*) Cast-iron hub and spigot, straight pipe; placed or laid.
(*q q*) Special castings, placed or laid.
(*r*) Wrought-iron, laid in the work.
(*s*) Stop cocks, 48 in., complete in place.
(*t*) Windows, 4 × 7 ft., placed.
(*t t*) Iron double door, 7 ft. 6 in. × 13 ft., placed.
(*t t t*) Combination iron fencing.
(*u*) Galvanized iron "Excelsior" ventilators, 12 in., placed.

Wharf.—Littlefield & Co. have the contract for piling for a wharf for the Union Mill & Warehouse Co., Brunswick, Ga.

Street Work.—The following proposals for grading and cobblestone paving on Van Voorhis St. have been received by the Commissioner of City Works, Brooklyn, N. Y.: Luck & Fitzgerald, $4.93 per lin. ft.; Daniel Gallagher, $4.45; Henry Mogk, $4.09; Harris Bogert, $3.70; W. J. Hickey, $3.25.

Sewers.—The following proposals have been received by the Board of Public Works, Houston, Tex. The contracts for the first two pieces were awarded to Jerry Shea of Quincy, Ill., and for the third to Morley & Lidwell, of Kansas City, Mo.

Chartres Street Conduit.

Jerry Shea	$21,942.73
Isaac Heffron	24,001.10
O'Connor, Lang & Smoot	24,702.83

Labranch Street District.

Jerry Shea	$55,011.86
Morley & Lidwell	72,152.28
Isaac Heffron	78,379.23
O'Connor, Lang & Smoot	88,414.52

San Felipe Street District.

Morley & Lidwell	$48,386.09
Jerry Shea	48,478.56
Isaac Heffron	59,654.90
O'Connor, Lang & Smoot	61,613.16

Pier.—The Asbury Park & Loch Arbor Pier Co., capital stock $200,000, will build a pier near Asbury Park, N. J., in front of Life-Saving Station No. 5. The pier will be T shaped, and will extend 500 feet into the sea. The outer portion of the pier will be 80 by 100 ft., and the narrower portion, extending to the shore, will have small piers branching to either side and fitted with seats. The contract for iron work has been awarded to the Phœnix Bridge Co.

Building Supplies.—The following proposals have been received by B. F. Green, Engineer and Superintend-

Items.	Quantities.	Chas. H. Raynor, Syracuse, N. Y.	Chas. Peterson, New York.	O'Brien & Clark, New York.	F. Thilemann, Jr., New York.	J. C. Rodgers, New York.	Washburn, Shaler & Washburn, New York.	Smith & Brown, New York.	M. S. Coleman, New York.	Clinton Stephens, Brooklyn, N. Y.	Breuchaud, Pennell & Co., New York.	D. R. Paige & Co., New York.	Engineer's Estimate.
		$	$	$	$	$	$	$	$	$	$	$	$
a	4,000 cu. yds.	.75	.40	.20	.30	.35	.25	.25	.30	1.00	.40	.30	.25
aa	2,000 "	.35	.40	.20	.30	.30	.40	.30	.40	.33	.27	.30	.30
b	12,000 sup. yds	.15	.15	.40	.25	.30	.30	.10	.25	.25	.27	.30	.30
c	500,000 cu. yds.	.40	.33	.32	.30	.25	.25	.31	.30	.50	.29	.30	.32
cc	5,000 "	.02	.02½	.01	.05	.04	.01½	.03	.03	.05	.05	.02	.01
d	33,000 "	1.75	1.50	2.00	1.40	2.00	2.25	1.50	1.40	2.50	2.00	1 50	1.75
e	100,000 ft. B. M.	45.00	40 00	25.00	35.00	40.00	30.00	38.00	40.00	40.00	40.00	32.50	40.00
ee	75,000 "	55.00	50.00	30.00	40.00	50.00	32.00	48.00	50.00	50.00	50.00	45.00	60.00
f	200 bbls	3.50	2.50	2.00	2.75	3.50	2.75	3.00	3.50	3.00	3.00	3 25	2.50
g	1,000 cu. yds.	4.50	4 00	4.00	4.00	6.00	4.00	4.25	4.50	5.00	5.00	4.00	5.00
gg	500 "	5.00	5.00	5.00	5.00	7.00	4.50	6.25	6.00	6.00	6.00	5.00	6.00
h	500 "	12.00	12.00	11.00	14.00	12.00	12.00	12.50	12.00	10.00	12.00	12.00	10.00
hh	50 "	25.00	25.00	15.00	14.00	14.00	13.00	20.00	25.00	20.00	15.00	20.00	20.00
i	140,000 "	4.50	4.50	3.90	4.00	3.75	3.40	4.00	3.75	4.00	3.85	4.25	4.50
ii	12,000 "	3.00	3.50	3.00	3.25	3.00	2.00	2.75	2.50	2.75	3.00	2.25	3.50
j	3,000 "	1.50	1.50	1.50	1.00	1.50	1.75	1.75	2.00	1.50	1.50	1.50	1.50
k	8,000 "	1.75	1.50	1.50	2.25	1.00	2.00	2.00	1.50	1.50	1.50	1.10	2.00
l	800 "	20.00	25.00	4.00	15.00	6.00	15.00	12.50	12.00	13.00	5.00	12.00	16.00
m	1,100 "	38.00	75.00	38.00	30.00	28.00	30.00	35.00	32.50	27.00	30.00	35.00	35.00
mm	5,000 "	17.00	10.50	12.00	10.00	11.00	12.00	12.00	12.00	11.00	11.50	20.00	15.00
n	25,000 sq. ft.	.30	.05	.50	.50	.30	.30	.25	.50	.40	.40	.50	.25
nn	15,000 "	.70	.70	.80	.50	.75	.50	.50	.50	.60	.70	.80	.75
nnn	17,600 "	.30	.25	.50	.50	.35	.20	.40	.25	.40	.40	.60	.40
o	5,000 cu. yds.	.70	1.50	1.00	1.25	1.40	.70	.75	.80	1.00	1.50	1.15	.65
p	500 "	3.00	2.50	1.25	2.75	3.50	2.50	2.00	3.00	2.50	3.00	3.00	2.50
pp	15,000 "	1.30	1.50	1.25	2.00	2.50	1.75	2.00	1.50	1.50	2 50	1.75	1.50
ppp	25,000 "	.70	1.00	1.00	1.50	.50	1.00	1.75	1.00	1.00	.50	1.25	.70
q	70 tons	55.00	40.00	35.00	40.00	50.00	38.00	40.00	40.00	60.00	50.00	35.00	35.00
qq	100 "	100.00	70.00	50.00	90.00	75.00	100.00	30.00	80.00	90.00	80.00	60.00	75.00
r	20 "	150.00	100.00	100.00	100.00	100.00	100.00	60.00	100.00	100.00	95.00	100.00	110.00
s	2	2,500.00	1,500.00	3,000.00	2,000.00	1,400.00	1,500.00	1,700.00	1,500.00	1,300.00	1,500.00	1,500.00	1,500.00
t	3	100.00	10.00	400.00	25.00	50.00	25.00	30.00	100.00	20.00	100.00	75.00	75.00
tt	1	300.00	400.00	500.00	100.00	400.00	500.00	200.00	350.00	100.00	600.00	150.00	300.00
ttt	630 lin. ft.	5.00	2.50	3.00	3.00	2.00	2.50	3.50	3.50	5.00	3.00	5.00	3.00
u	2	50.00	10.00	100.00	20.00	15.00	15.00	20.00	20.00	20.00	10.00	25.00	15.00
	Totals	$1,205,025	$1,129,400	$1,055,065	$1,061,030	$991,440	$993,065	$1,064,810	$998,845	$1,168,060	$1,031,240	$1,124,450	$1,151,195

dent of the Congressional Library Building, Washington, D. C.:

Hand-made bricks. Washington Brick Machine Co., $13.23 per 1,000; C. R. Monroe & Co., $12.50; A. Richards & Co., $11.50; B. F. Winchester, Frederick, Md., $12. Contract awarded to A. Richards & Co.

Red hard-burned regular and skewback brick. Washington Brick Machine Co., Washington, D. C., regular, $9.23 per 1,000; skewback, $15.23. A. Richards & Co. Washington, regular, $9.45; skewback, $13.50. Contract awarded to the Washington Brick Machine Co.

Portland cement. Jackson-Jones Co., $3.03 per bbl., M. M. Ruttenan, New York, $2.66; Morris Egbert, Philadelphia, $2.74; J. E. Bates, $2.68; William C. Lewis & Co., $2.67½; Sinclair & Babson, New York, $2.98.

Sand. James T. Summers, fine and coarse sand, 98 cts. per cu. yd.; John B. Lord, $1. Contract awarded to J. T. Summers.

Broken stone. H. P. Gilbert, $2.23 per cu. yd. H. L. Atchison, $2.10. Contract awarded to H. L. Atchison.

Cast iron drain and pressure pipe: contract awarded to Henry McShane & Co., Washington, at $49.30. Lumber: contract awarded to Libbey, Bittinger, & Miller, Washington, at $3,183. Small castings: contract awarded to Geo. White & Sons, Washington, $598. Hardware: contract awarded to W. T. Weaver, of Washington, at $681.33.

Rope.—The following proposals for 1¼ coils of Manila rope have been received by the Dock Commissioners, New York City: James S. Barron & Co., 13 cts. per lb., less 1 per cent.; H. A. Rogers, 13¼ cts.; Alexander Pollock, 13¼ cts.; Wm. Wall's Son, 14½ cts. net.

River Improvement.—At Winnipeg, Man., the city council proposes to take early action regarding the improvement of the navigation of the Red and Assiniboine rivers. The city engineer estimates that the cost will be $1,500,000.

PROPOSALS OPEN.

Jail.—Brick jail building at Seguin, Texas. All work except iron work. L. T. Noyes, Diebold Safe & Lock Co., Houston, Tex.

Sewer.—About 1,710 ft. of 36 × 26 brick; 70, 40, 525 and 500 ft. of 18, 15, 12 and 6-in. pipe, 23 manholes, 5 basins, 700 cu. yds. rock excavation, 7,000 ft. B. M. of timber, 25 cu. yds. of concrete. The Parks Commissioners, 49 Chambers St., New York City. Feb. 19.

Stone and Gravel.—About 16,500 cu. yds. of 2½-in. broken stone, 7,000 cu. yds. of trap rock screenings, 2,500 cu. yds. of Roa Hook screened gravel. Also 9,000 cu. yds. of double screened Roa Hook gravel for roads and drives. The Parks Commissioners, 49 Chambers St., New York City. Feb. 19.

Pipe Laying and Supplies.—Laying water mains; furnishing chestnut poles and posts; bolts and iron; hydrants, nozzles, plugs and stop-cock boxes; lead pipe and solder; 3,800 street lamps; 800 cast-iron lamp posts. The Commissioner of Public Works, 31 Chambers St., New York City. Feb. 19.

Masonry.—Stone and brick masonry of the U. S. building at Port Townsend, Wash. Jas. H. Windrim, Supervising Architect, Treasury Department, Washington, D. C. Feb. 20.

Building.—Completing the town hall. H. S. Stiles, Town Clerk, Richwood, O. Feb. 21.

Pipe and Asphalt.—About 200 lengths of 48-in. cast-iron water pipe. Asphalt walks for Lehigh Ave. and Corinthian Ave. basins. Louis Wagner, Director of Public Works. Philadelphia, Pa. Feb. 21.

Electric Lighting.—Lighting the city of New Castle, Pa., for a term of five years, with not less than 50 arc lights of 2,000 c. p. J. H. Miller, City Clerk, New Castle, Pa. Feb. 24.

Railway Work and Cross Ties.—Grading and masonry of Ohio extension, from Elkhorn, W. Va., to Ironton, O., 195 miles. Foundations and 12,000 cu. yds. of masonry in five piers and one abutment, for the bridge over the Ohio River, near Ceredo. Cross ties for 195 miles of line, about 3,000 ties per mile. W. W. Coe, Chief Engineer, Norfolk & Western R. R., Roanoke, Va. Feb. 26.

Dike.—About 2,950 ft. of timber and stone dike in the Hudson River, 12 miles below Albany. Lieut. Col. G. L. Gillespie, U. S. Engineer Office, New York City. March 3.

Cells.—Cell work, etc., of police station. Architect, Wm. C. Smith. The Board of Public Works, Nashville, Tenn. March 4.

Bridge.—Iron bridge across the Thames River; two stone abutments. L. E. Vogler, Bothwell Bridge Commission, Bothwell, Ont. March 5.

MANUFACTURING AND TECHNICAL.

Filter.—The Columbia Athletic Club, of Washington, D. C., has awarded a contract to the National Water Purifying Co. for a National filter plant.

Sewer Pipe.—Manufacturers of sewer and drain pipe are requested to send samples, and state lowest price delivered, free of breakage, to T. A. Huguenin, Superintendent of Streets, Charleston, S. C. About 10,000 ft. of 10, 12 and 15-in. pipe will be required.

The Ball Engine Co., of Erie, Pa., reports shipments for January of 21 engines, aggregating 1,700 H. P.

Car Couplers.—The Van Dorston Car Coupler Co., of Philadelphia, Pa., has given an order to the Chicago Malleable Iron Co. for 8,000 couplers.

Anti-Friction Metal.—The Magnolia Anti-Friction Metal Co., of New York, has issued a circular containing letters and tables in regard to comparative tests of this and other metals for railway and other service.

The Birmingham Railway Supply Co., of Birmingham, Ala., will increase its capital stock to $300,000.

Sewer Pipe.—The Coosa Sewer Pipe Co., Gadsden, Ala., will put in a plant at a cost of $40,000.

Pavement.—The Composition Pavement & Sidewalk Co., of Chicago, has been incorporated by F. J. Hoyt, M. Weston and J. G. Hoyt.

Cars.—The Ohio Falls Car Co., of Jeffersonville, Ind., has built 500 of an order of 700 box cars for the Pennsylvania. It has also orders for 1,200 box cars and 25 cabooses for the Georgia Central. Also for seven passenger cars for the Savannah & Montgomery.

The St. Charles Car Co., of St. Charles, Mo., has built all the new standard gauge passenger cars for the Denver & Rio Grande Western. The cars are carried on four-wheel trucks with Paige 33-in. wheels. They are equipped with many improvements to contribute to the comfort or safety of passengers. They have the Westinghouse quick-acting valves and air signals, they are heated by steam from the locomotive, and lighted by the Pintsch compressed gas system. They have the Johnson car seat with improved roll head.

The Lafayette Car Works, of Lafayette, Ind., are building 250 Chase refrigerator cars for the Kansas City Packing Co.

The South Baltimore Car Works, of Baltimore, Md., have an order for 200 box and 250 coal cars for the Baltimore & Ohio Southwestern. Another installment of the 250 drop bottom gondola cars for the West Virginia Central has been delivered. An order has been received from the Wilmington & Northern. Since Jan. 1, 62 cars have been delivered to the Atlantic Coast line.

The new coal cars which the Columbus, Hocking Valley & Toledo is to buy will be of 25 tons capacity each and 35 ft. in length. The old style of coal cars, with which the road is so well equipped, have a capacity of 14 tons. The new cars are for summer delivery.

The New York & Northern will purchase new rolling stock equipment.

The Duluth & Winnipeg will shortly let contracts for freight and passenger equipment.

About 15 to 20 second-hand flat cars wanted: standard gauge, 35,000 to 40,000 lbs. capacity. P. O. Box 223, Savannah, Ga.

The Standard Oil Co. will erect works at Whiting, Ind., for the construction of oil-tank cars.

Rails.—The Reliance Lumber Co., Beaumont, Tex., wants prices on 10 miles of 30-lb. steel rails, new or second hand, in good condition.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., have an order for 12 passenger engines of exceptional power. They are to be capable of hauling 7 to 10 Wagner cars. Cylinders, 19 × 24 ins. Driving wheels, 70 ins. diameter, with 85,000 lbs. on the two pair. Journals of driving axles, 8½ × 10½ ins. Boiler, 58 ins. diameter. Fire box, 8 ft. long. Total weight, 115,000 lbs. These engines are for the New York Central.

The Portland Co., of Portland, Me., is building a freight engine for the Windsor & Annapolis. Weight, 40 tons.

The Baldwin Locomotive Works, of Philadelphia, Pa., have built 3 engines for the Birmingham, Powderly & Bessemer. The order for 75 engines for the Northern Pacific includes 50 freight and 25 passenger engines.

The Staten Island Rapid Transit road will add 5 engines to its equipment.

The Pittsburg Locomotive Works, of Pittsburg, Pa., are building 5 freight engines for the St. Louis, Vandalia & Terre Haute.

Mr. Chas. Watts, Superintendent of the Chicago Division of the C., St. L. & P., is said to claim to have the fastest locomotive on the Pennsylvania system. It is a new engine, class "O," with 66-in. driving wheels. This engine is said to have hauled a train of 4 cars for several miles at a speed of 68 miles an hour, and it is claimed by the engineer that its highest speed was not then reached.

The King Locomotive Co., which will erect works in Bordentown, N. J., has been organized with the following officers: President, John A. King; Vice President, E. A. King, of New York; General Manager, John Hedding, of Paterson; Treasurer, J. Holmes Longstreet, of Bordentown; Secretary, T. L. Carpenter, of New York.

The New York Locomotive Works, of Rome, N. Y., will, it is reported, be removed to East St. Louis, Ill. The officers of the firm have been in correspondence with the officers of the Merchants' Bridge & Terminal Co. for two or three months past, and the Merchants' Bridge Co. promised a donation of a site as an inducement to locate there.

Snow Plows.—The Portland Co., of Portland, Me., recently shipped to the Montpelier & Wells River road a double end snow plow to be used on the Barre branch, which is a switch-back road. The company has in course of erection a Russell elevator snow plow for the Central New England & Western. This is the largest type of push plows used, and is the first one to be built in the United States, although there are 17 already in use in Canada and the British Provinces. Its weight will be about 33 tons.

The Pond Machine Tool Co., through its selling agents, Manning, Maxwell & Moore, 113 Liberty street, New York, has received an order from the Ordnance Department of the U. S. Government for 10 large lathes, for the work of turning, boring and finishing guns of 8 to 12 ins. calibre. The contract amounts to $247,800. The time of delivery extends over a period of about three years, which enables the company to take care of its regular work promptly, and does not materially reduce the production of its shops for regular railway and machine shop trade.

Filters.—The National Water Purifying Co. has been awarded a contract for a filter plant of 500,000 galls. capacity for the Arlington paper mills, which are operated by the Ramsdell interest of Newburgh, N. Y.

Tie Plates.—The Dunham Mfg. Co., of Boston, Mass., has received an order for 136,000 Servis railway tie plates for the Pacific Short Line, now being constructed from Sioux City westward to Forest City and ultimately to a Pacific Coast connection.

Signals.—The Martin Electric Signal Co. has been incorporated at Portland, Me. Capital stock, $500,000. President, R. D. Weston Smith; Treasurer, Edwin Sheafe.

Machine Tools.—The contract for machinery for the King Locomotive Works, of Bordentown, N. J., has been awarded to Bement, Miles & Co., of Philadelphia.

Freight House.—The Lehigh Valley R. R. Co. will erect a corrugated iron freight house in Jersey City.

Brick.—The Litchfield Tile & Brick Co., of Litchfield, Ill., has put in a machine for making paving brick, and has ordered an engine from the Litchfield Car & Machine Co.——The Beatrice Sewer Pipe Co., of Beatrice, Neb., has purchased a plant for the manufacture of pressed brick. ——The Boylston Brick & Mfg. Co., of Superior, Wis., has been incorporated by W. S. T. Silver, T. G. Russell and J. T. Ware. Capital stock, $10,000.

Asphalt.—The Tacoma Asphalt Co., of Tacoma, Wash., has been incorporated by Edward M. Hunt, H. C. Clement and H. B. Dunn. Capital stock, $27,000.

Frogs and Switches.—The Kansas City Frog & Switch Co., of Kansas City, Mo., has orders for 400 frogs for the Union Pacific and 200 frogs, switches and stands for the Fort Scott & Gulf.

Pier Work.—The Philadelphia contractors at work at Lambert's Point, Norfolk, Va., are rapidly putting down creosoted piles for the substructure of the several piers and warehouses to be erected there. They have several pile-drivers at work and a large force of men. The coal pier is to be of iron, and the freight piers of wood, with docks 200 ft. wide and 28 ft. deep between them.

Car Heating.—George Westinghouse, Jr., and C. H. Jackson, President and Vice-President of the Standard Car Heating & Ventilating Co., of Pittsburg, Pa., have become directors and large shareholders in the Consolidated Car-Heating Co., of Albany. The interests of the Pittsburgh company are thus consolidated with the Albany company, which, by the arrangement, greatly extends the field of its operations, and becomes the owner of an additional number of valuable patents and improved devices for heating and ventilating railway cars, and for lighting such cars by electricity. Automatic regulation of heat, which will obviate the complaints of the variable temperature of steam-heated cars, is also secured by an attachment to the air-brake cylinder with which all cars are already equipped. Several of the features of the heating systems of the Standard Company have lately had considerable trial upon the Pennsylvania and the Baltimore & Ohio railways.

Metal Market Prices.—***Rails.***—New York, $35 to $36. Chicago: $38; old rails, $24.50 to $25.50 for iron and $20 to $21.75 for steel. Pittsburg: $35 to $36; old rails, $28 for iron, $23.50 to $24 for steel.

Track Materials.—New York: steel and iron angle bars, $2.10; spikes, $2.20 to $2 25. Pittsburg: splice bars, 2.10 to 2.20 cts.; spikes, $2.15, or $2.25 delivered at Chicago, Milwaukee, or St. Louis; track bolts, 3.10 cts. with square and 3.20 cts. with hexagon nuts. Chicago: splice bars, 2.25 cts. for steel and 1.90 to 2 cts. for iron; spikes, 2.25 to 2.30 cts.; track bolts, 2.80 to 2.85 cts. with square and 2.95 to 3 cts. with hexagon nuts.

Pipe.—Cast iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded, 60 and 47½ on black and galvanized lap-welded.

Lead.—New York, 3.80 to 3.82½ cts.; Chicago, 3.65 to 3.67½ cts.; St. Louis, 3.60 cts.

Barb Wire.—Chicago. At a meeting of manufacturers and dealers on Feb. 5, the price of painted was advanced to 3.45 cts. for small lots and 3.35 cts. for carload lots. Galvanized is an advance of 60 cts. per 100 lbs. on painted.

Nails.—Pittsburg. Cut nails, $2.50; wire nails, $2.60.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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RAILWAY EARNINGS FOR THE MONTH OF JANUARY, according to figures collected by *Bradstreet's*, show a very favorable increase over the corresponding month of last year. The reports of 143 roads show for Jan. 1890, gross earnings aggregating $31,407,203, on a mileage of 77,210 miles, against gross earnings aggregating $27,633,530, on a mileage of 75,582 miles, for Jan. 1889, an increase of 13.9 per cent. in earnings, and 2.1 per cent. in trackage. Only the Eastern roads show a decrease. The Granger roads show the most favorable results, the increase being 21 per cent. The favorable showing of the Southern roads, an increase of 17.3 per cent, notwithstanding the larger proportionate increase in mileage, speaks well for the industrial growth of that part of the country.

THE SENATE COMMITTEE ON PACIFIC RAILROADS has finally agreed upon a bill for adjusting the debt of the Union Pacific and Central Pacific railroad companies to the United States. The bill provides for ascertaining the present worth of this debt, and requires its payment, with 3 per cent. interest, in semi-annual installments. These are to be so arranged that the Union Pacific's debt would be extinguished in 50 years and the Central Pacific's debt in 75 years. The debt of the latter company is to bear interest at only 2 per cent., and this is to be capitalized for ten years while the company is getting on its feet. Ample provision is made for securing the debt by mortgages on all properties of the companies, and the difficulties under which the companies now labor with regard to building extensions are removed. In case the companies refuse to accept the provisions of the bill, it is provided that 75 per cent of their net earnings shall be placed in the sinking fund. In case of failure to pay, a receiver s to be appointed, with authority to take charge of and operate the road until the whole debt, principal and interest, has been paid.

CONCERNING ARGENTINE RAILWAYS, the Buenos Ayres *Standard*, of Jan. 1, says: Up to the present there are in working order and in course of construction 27 lines of railways, seventeen of which have national and ten provincial concessions. Their total length is 11,068 kilos., viz., 7,450 kilos. granted by the nation and 4,218 kilos. by the provinces. The guarantee several of these lines enjoy extends over a capital of $27,682,867 gold. Furthermore, 92 new concessions have been granted, embracing a length of 38,000 kilos. and a guaranteed capital of $312,541,900 gold. Of the 92 new concessions, 56 are national, with a length of 25,225 kilos., and 36 are provincial, with a length of 12,775 kilos. These figures are not complete, but they are near the mark. Of the 92 railway concessions applied for before the Congress of 1889, 45 were reported on favorably by the Department of Engineers. The length of railways working, in course of construction or conceded amounts to 49,068 kilos. The amount of capital guaranteed thereon reaches $440,224,767 gold. This figure, of course, excludes the capital of lines not enjoying Goverment guarantees.

THE PERUVIAN BONDHOLDERS' COMMITTEE have reported in connection with the GRACE contract with Peru made last November. The contract has been already noted, and the chief points of the committee report can be summarized as follows: The committee expects to get £925,000 from Chili, after paying off the Pisco-Yca bondholders, and from Peru a total annual income of $1,430,000 in the next three years, after deducting $400,000 to be allowed for that term to the Peruvian Government. The work contemplated is first the extension and repair of the seven existing Peruvian railway systems at an estimated cost of $3,212,000. It is then proposed to extend the Southern Ry. of Peru from Puno, its present terminus, on Lake Titicaca, to Desaguadero on the Bolivian frontier, by a narrow-gauge line, thus doing away with the transfer of goods at the lake. (2) To continue the line from Desaguadero to La Paz and to Oruro in Bolivia, at an estimated cost of $3,150,000. The existing revenue from railways is $630,000, which will also be available to the bondholders. Another concession in their hands empowers them to connect the Central Ry. system with the navigable waters of the Amazon by 180 miles of narrow-gauge road.

A CONSOLIDATION OF THE BALTIMORE & OHIO WITH THE NORTHERN PACIFIC has been rumored to be under way this week, and though there has been little to confirm the report, such an alliance would not be the strangest of occurrences. It would be much more likely, however, to take the form of an alliance similar to that made between the Union Pacific and the Chicago & Northwestern, than an actual consolidation. Should it be consummated, it would be the first through line under one management to extend from the Atlantic to the Pacific on American soil.

THE PROPOSED LEASE OF THE CHESAPEAKE & OHIO CANAL to the West Virginia Central Ry. Co. is the one topic in Maryland politics. The railway company bids $1,400,000 for a nominal lease of 99 years, renewable forever. While the Governor of Maryland approves of it, other parties claim that this newly-fledged railway company will obtain a right-of-way paralleling the Baltimore & Ohio R.R. at an exceedingly cheap rate. It gets 184 miles of practically graded roadbed, with expensive bridges, a tunnel costing a million dollars and much valuable property in the District of Columbia and at Cumberland. Eternal litigation is threatened if this bid is accepted.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision, Feb. 14, on the Louisville, New Albany & Chicago Ry., near Mitchell, Ind. The engine driver of a freight train instead of waiting on a side track for a passenger train to pass, started to reach Mitchell, thinking he could get there in time. The engine, baggage car and smoking car of the passenger train were wrecked. The wreck caught fire, but the flames were quickly extinguished. Three men were killed and about ten injured.——A rear collision occurred, Feb. 15, on the Cincinnati Southern Railway at Mellville, Tenn. A freight train was standing on a side track and a flagman had been sent back to flag a following freight. Instead, he flagged a passenger train and returned. The freight train backed onto the main track as soon as the passenger train had passed, and was run into by the following freight. Two men were killed.—— Two misplaced switch accidents have occurred: on the Lake Shore & Michigan Southern Ry., at Bellevue, O., Feb. 13; on the Central Massachusetts R. R., at Ware, Mass., Feb. 15.

A DECIDEDLY REMARKABLE ACCIDENT is described by a daily paper as having occurred to a freight train Feb. 14, on the Union Pacific Ry., near Odessa, Mo.

"On account of unavoidable delays and through the absence of orders it was caught between stations and was running on the time of the fast mail train. The engineer of the freight tried to find a siding to crawl into to avoid a collision. The heavy Mogul was pushed to its utmost driving capacity. Coal was piled into the fire box, and the engine, responding to the will of the engineer, flew over the track at a speed never before attained by a freight train. Just before Odessa was reached the driving-wheels of the engine were melted, or burned off, and they left the rails, and the cars behind were piled upon each other."

Either the reporter must have had a fertile and imaginative mind, or else here is a new obstacle to obtaining high speeds. Railways cannot afford to run their engines at such a rate that the driving wheels will melt or burn off.

TWO LOCOMOTIVE BOILER EXPLOSIONS have occurred: On Feb. 13, the boiler of an engine hauling a passenger train on the Pittsburg, McKeesport & Youghiogheny R. R. exploded while near Douglas station, Pa. Two men were killed and three injured. The boiler of an Old Colony R. R. engine also exploded while hauling a passenger train near Roxbury, Mass. Nobody was injured.

A BRIDGE OR TRESTLE over Chisholm creek, near Wichita, Kan., on the Atchison, Topeka & Santa Fe R. R., gave way under a passenger train Feb. 17. One man was killed and five were injured. The supports had been burned away by tramps.

SPEED OF TRAINS WITHIN THE CITY LIMITS OF CHICAGO is to be reduced to 10 miles per hour, according to unofficial reports, to secure the repeal of a city ordinance prescribing that as a maximum speed. This is on the principle of GRANT'S saying that the best way to repeal a bad law is to enforce it. The move would meet such serious opposition from the dwellers in the suburbs, who depend on the railways for passage to and from business, that it is believed the obnoxious ordinance, which is now practically a dead letter, but which makes the railway responsible for many casualties at grade crossings, where it would otherwise escape, would be at once repealed.

The *Chicago Tribune* very sensibly points out that while the railways should not be forced to break the law in order to carry their passengers with reasonable dispatch, the permission to run at speeds up to 30 or 40 miles per hour should be granted to them only on condition that they agree to at once set about the work of removing grade crossings and providing flagmen for crossings not already so protected.

WHY FASTER TIME IS NOT MADE BETWEEN BOSTON AND NEW YORK is the subject of an investigation by the Railroad Committee of the Massachusetts Legislature. The order for the investigation was introduced by Representative JOSIAH QUINCY, who stated that the New York, New Haven & Hartford Co. was the chief corporation opposed to a reduction of time. This is the first instance in this country, so far as we recall, where the matter of too slow train service has been made the subject of a legislative investigation.

COMPULSORY AUTOMATIC CAR COUPLING is the subject of a bill presented to Congress by Representative FLOWER, of New York. The bill recites that, in view of the numerous accidents and loss of life resulting from the present system of coupling railway cars by hand, a bill requiring all railway companies to equip their freight and passenger trains with automatic couplers has become a necessity. The act is to be operative after Nov. 1, 1892. The Interstate Commerce Committee may in special cases extend the time one year longer. Failure to comply with the provisions of the act subject the offenders in each case to a fine of $500.

THE PNEUMATIC DYNAMITE GUN CO. has received an order from Great Britain for 50 pneumatic dynamite guns with air reservoirs, carriages, etc. The cost will be not far from $30,000 each. The order is conditional, however, on the satisfactory operation

of a trial 15-in. dynamite gun, soon to be shipped from here and tested at Shoeburyness. The gun, which is now at Cold Spring, N. Y., will be ready for shipment early next month, and preparations for its test are already going forward.

A LARGE CONTRACT FOR ELECTRIC RAILWAY EQUIPMENT was closed on Feb. 19, under the terms of which the street railways owned by the Minneapolis Street Ry. Co. and the St. Paul City Ry. Co., with a total extent of 110 miles, are to be equipped with the system of the Sprague Electric Ry. & Motor Co. The cable plants now in extensive use on the roads are to be discarded.

THE STANDARD ELECTRICAL SUBWAY CO. will probably soon have control of all the electrical ducts and subways in this city used for electric light and power, excepting the Edison ducts, in spite of vigorous opposition against the decision of the Board of Electrical Control to award the contract to this company. The Consolidated Telegraph & Electrical Subway Co. would still control the subways for telegraph and telephone wires. The latter company is stated to have already expended $2,000,000 on the subways constructed. Both companies claim a right to charge rentals equal to ten per cent. on the cost of subways, above expenses of operation and maintenance. With the wires thus divided an extra set of subways must be built; and, as a consequence, more streets torn up, says Commissioner GILROY.

THE ERICSSON COAST DEFENSE CO. is made the subject of a bill introduced into Congress on Feb. 15, asking that the Secretary of the Navy appoint a board of naval officers to inspect the plans and specifications of this company for constructing submarine guns and "detachable explosive rams." If the report is favorable, the Secretary is authorized to purchase, for $175,000, the gun and carriage equipped complete, ready for service. The bill also appropriates $1,500,000 for the purchase of ten or more of these guns should the test be favorable.

SHIPPING IRON FROM ALABAMA TO PITTSBURG seems somewhat akin to "sending coals to Newcastle." But it is done; and on Feb. 17, Sheffield, Ala., sent 5,000 tons by nine barges down the Tennessee and up the Ohio rivers. The barge freight was $2.50 per ton, which is so much less than by rail that it is said arrangements are being made to market the entire product of the five Sheffield furnaces by this route.

THE RIVER AND HARBOR ESTIMATE for the next fiscal year is $39,000,000, as figured by the U. S Engineers. Mr. HENDERSON, Chairman of the House Committee on Rivers and Harbors, says, however, that he thinks this sum will be reduced to $25,000,000; but that is the lowest sum that can be recommended consistent with the work needed. New York State alone wants in round figures $2,250,000, the largest items being Harlem River, $500,000; re-

of 54 machines working during the two years, the average output of each has been about 926 cu. yds. per day. The total number employed during the past summer was 12,000 men and boys.

THE PANAMA CANAL is to be reported against by four of the French engineers sent out to examine it, says the New York *Herald*. These engineers are now in the United States on their way to Paris with their notes. They do little talking, but intimate that the Panama Canal is "but a bad dream," and one of them states that sufficient confidence can never again be aroused to raise the vast amount of money necessary to complete it.

THE PROPOSED JUNGFRAU RAILWAY, in Switzerland, is assuming a somewhat more tangible shape. Two plans have been submitted for the ascent of this peak, one by MORITZ KÖCHLIN and another by Mr. TRAUTWEILER, engineer of the St. Gothard and Brunig railways. The first plan is receiving the most favorable consideration, and includes a line 3¼ miles long, built either on the Mt. Pilatus rackrail system, or to be divided into five sections of cable-line worked by water power. A reservoir on the summit, supplied by pumps from below, would furnish the power. Mr. TRAUTWEILER proposes a covered road throughout, to escape climatic influences. He would build four sections of a large pipe conduit and operate it by cable with compressed air as a motive power; the air to be compressed by water power. Mr. KÖCHLIN'S estimate of cost is $1,950,000; and Mr. TRAUTWEILER wants $1,150,000.

THE COST PER FOOT OF SPACE in Machinery Hall at the Paris Exposition was $2.18 per square foot of space covered, says Mr. OCTAVE CHANUTE, C. E., in a late address before the Western Society of Civil Engineers. This was less than that of an ordinary wooden cottage in Chicago, but it was about two and one-half times as much as the cost of the buildings adjoining the great Machinery Hall of M. DUTEXT. The Fine Arts Palace and the Liberal Arts Palace, designed by M. FORMIGE, cost $3.09 per square foot of floor space, but these buildings were practically two stories in height. Mr. CHANUTE says that the French authorities have decided to retain the Machinery Hall, the main transept and central dome, as well as the Fine Arts and Liberal Arts buildings. They do this because the experience of 1878 taught them that to sell the old material was simply to sacrifice it.

THE WORLD'S FAIR BILL has passed the Albany lawmakers at last, and the unseemly political squabble over a matter that should not be in politics at all, seems to be over. As a consequence of this settlement of differences between party leaders, the prospects of the Fair before Congress are much improved.

THE GRAND PACIFIC HOTEL in Chicago, one of the finest hotels in America, and a model high-class establishment with overflowing patronage, is to be torn down and replaced by a business block. The reason given is that the rent is based upon the value of the [illegible], and this has increased to such an

The Cable Railway Tunnel Under the Chicago River, Chicago, Ill.

(WITH INSET.)

In our issue of Dec. 7, a short account was given of the tunnel now under construction under the Chicago River, at Chicago, Ill. Through the courtesy of Mr. SAMUEL G. ARTINGSTALL, C. E., the Chief Engineer, we are now enabled to present sections and the plan and profile of this interesting work.

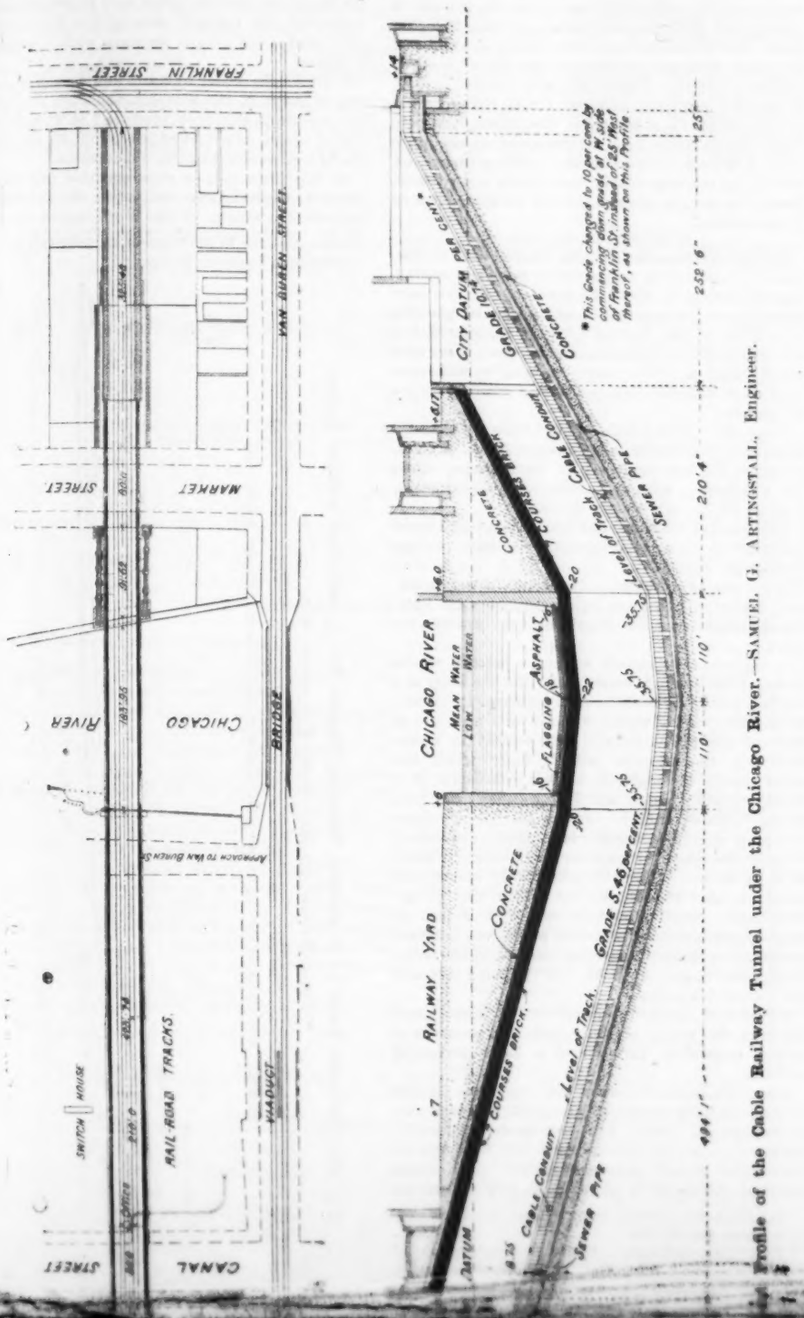
The tunnel is being built by the West Chicago Street Railway Company, and as shown is being fitted for double-track cable traction. It crosses the Chicago River about 150 ft. north of Van Buren Street (see Fig. 1), and at the shore ends it passes under several large buildings requiring underpinning and essentially new foundations over the tunnel. The plan and profile show with sufficient clearness the general position of the tunnel with reference to the river and adjoining streets and buildings.

The tunnel will be lined with hard-burned brick laid as hereinafter described. Utica cement is specified for use when natural cement is to be employed. The concrete, however, is to be made of Portland cement mortar, with sand, and broken limestone in cubes not exceeding 3 ins. in any dimension. The concrete mortar will be one part cement to three parts sand by measure, and to this mortar six parts of the broken stone is to be added. This concrete is to be spread in successive 4-in. layers and thoroughly rammed with rammers 4 ins. in diameter and weighing not less than 20 lbs. each. The face stone, when used, is to be "Buff Bedford," with beds and joints planed or bush hammered, and the rubble stone will be Joliet limestone as large in size as possible.

The tunnel, from the west line of Franklin to the east line of Clinton St., will be 1513 ft. long with the dimensions shown on the several sections. The gradients are given on the accompanying profile. The line is located upon private property, and besides passing under the buildings before referred to, also crosses under the tracks of the Pittsburgh, Fort Wayne & Chicago R. R., the Chicago & Alton R. R., and the Chicago, Burlington & Quincy R. R. on the approach to the Union Depot.

The contractors for building the tunnel are responsible for the safety of the buildings, etc., under which the tunnel is driven. The contract generally specifies that before any work on the tunnel is commenced, all buildings must be underpinned by extending the foundations downwards below the level of the tunnel bottom according to such plans as the engineer may devise and the conditions demand. All trenches are to excavated in short lengths and securely supported by close oak sheeting, struts, braces, etc.; this sheeting shall be caulked in such places where water may be troublesome, or there is any liability of settlement by escape of semi-liquid material.

The Springer Building, between Clinton and Canal streets, will have its west front supported on steel girders resting on stone piers, with footings of Joliet limestone. The east front will be carried on steel girders resting on piers built of Anderson pressed [illegible]



Profile of the Cable Railway Tunnel under the Chicago River.—SAMUEL G. ARTINGSTALL, Engineer.

below the tunnel level, and each capped on top by a granite block, 2 ft. thick by 4 ft. wide and 6 or 7 ft. long. Between these cylinders will then be turned brick arches, backed and underpinned to existing walls by brick masonry of Anderson clinker pressed brick, laid in Utica cement mortar in an alternate header and stretcher bond.

After these cylinders are in place, and the walls of the building secure, the floors will be supported by temporary trusses until the tunnel is finished. After this the cast iron columns supporting the floors will be replaced on piers of concrete and timber cribwork, as shown at the bottom of the inset illustration. This cribwork will be used for the purpose of distributing the weight over the surface of the tunnel while the concrete is wet. If sufficient time can be gained before the load is applied its use will not be necessary.

The open approaches will be faced with Bedford stone in regular courses ranging from 2 ft. to 18 in. in depth, and laid with an alternate header and stretcher bond. The backing will be of Joliet limestone in courses of the same thickness as the face. Portland cement is alone to be used in this portion of the work, and the foundations below them will be of Portland cement concrete.

The tunnel portal will be made of Bedford stone, as shown in the elevation on inset illustrations. The tunnel proper will be of brick masonry, in seven rings, or 32 ins. thick; excepting a length of 210 ft., under the railway tracks, where the thickness is increased, as shown on the drawings. The bricks will be laid longitudinally with the tunnel, with edges toward the centre and toothing joints. The joints must be perfectly filled by pressing the brick into the mortar, and not made by attempting to force mortar between the bricks. The joints between courses shall not exceed one-half inch in thickness, and between the rings the joints shall not be less than one-half inch.

The tunnel masonry will be laid generally in Utica cement mortar. But the bricks in the three outer rings, under the river and for 100 ft. on each side, a total distance of 420 ft., and in the two outer rings in the rest of the tunnel, will be laid in and grouted with asphalt cement mortar. This mortar is to be made of pure Trinidad asphalt and gypsum, with generally one part asphalt to three parts gypsum; to be mixed on the ground and furnished hot, ready for use in small quantities as required. No remelting of set or cold asphalt mortar is permitted. The invert, the backing and the filling over the haunches and crown of the tunnel will be Portland cement concrete, well rammed in place.

For the river section the top of the concrete filling will be covered with one inch in thickness of asphalt mortar, made as before described, and in this will be imbedded large flagstones, 12 ins. thick, with the joints grouted with asphalt mortar. The dock walls are to be built of Portland cement concrete, faced with Bedford stone in 2 ft. courses, and surmounted by a coping 2 ft. thick by 8 ft. wide.

Under the centre line of the tunnel, there will be a 12-in. drain pipe, with man-holes for cleaning 300 feet apart. Drain tiles, 4 ins. in diameter, will also be laid outside of the tunnel and about 50 feet apart, and these will connect with 4-in. cast iron pipe leading to the main drain. The main drain dis- into a sump on the east side, at which